Assessment of Water Saving Devices (WSDs) Sector in Jordan

WATER EFFICIENCY AND PUBLIC INFORMATION FOR ACTION (WEPIA)
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PREFACE AND ACKNOWLEDGEMENTS

This assessment provides the Ministry of Water and Irrigation (MWI) with an estimate of the amounts of expected water savings and the cost of procuring and installing WSD's in 25% and 85% of large water consumers, public and private. It is one more tool that the MWI can use to expand its ability to manage water demand in a country of great water scarcity. The assessment is the result of several months of extensive work by multi-disciplinary expert teams and stakeholders to determine who are the largest consumers of water in the Kingdom and how their consumption can be lowered to create a net water saving.

USAID/Jordan funded the Water Efficiency and Public Information for Action (WEPIA) program in January 2000, under its strategic objective of Improved Water Resources Management. WEPIA, in cooperation with the Ministry of Water and Irrigation (MWI) had a specific mandate to conduct an assessment that would provide accurate and timely information on the state of the supply and demand for water saving devices (WSDs) as a means for reducing water consumption rates by large water consumers. USAID requested a cost estimate for potentially retrofitting 85% of public buildings amongst the large consumers. WEPIA has an additional challenge in its cooperative agreement to persuade the 85% of the private sector amongst the large consumers to do likewise. This assessment looks at whether these aspirations are indeed feasible. It also looks at the cost of making them so.

WEPIA would like to take this opportunity to thank all those individuals who participated in the Assessment. Without the generosity of time and the willingness to share information and data with the WEPIA research teams that the managers and maintenance men of hospitals, hotels, restaurants, industries and commercial entities provided, this Assessment would not have been possible. Thanks are also due to the leaders of Government agencies who also shared their time and information. Particular thanks are due to the experts and to the participating agencies such as the Queen Rania Al- Abdullah Center for Environmental Science and Technology at Jordan University of Science and Technology who drafted this report, provided some of the technical specialists and provided University graduate students as field researchers. Many stakeholders and experts volunteered their time and effort and WEPIA is profoundly grateful to them. These are individuals with a love for their country and a passion for challenge who brought their expertise, their creativity and their concerns to WEPIA.

Finally WEPIA would like to thank USAID and the Ministry of Water and Irrigation for facilitating the Assessment, and ensuring its completion. To Dr. Hazem El Naser, Secretary General of the Ministry of Water and Irrigation, go my personal thanks for his support and guidance during difficult times.

Mona Grieser
AED Chief of Party/WEPIA

EXECUTIVE SUMMARY

The Water Efficiency and Public Information for Action (WEPIA) program, being implemented by the Academy for Educational Development (AED) has assessed the state of Water Saving Devices (WSDs) in Jordan with the broad objective of exploring the potential savings in water consumption and the conditions prevailing to retrofit large water consumers with WSDs. AED formed a multidisciplinary team of American and Jordanian specialists to assist with the task. The participating entities included: Best Management Partners (BMP), Cartelle Associates, Development Alternative Inc. (DAI), and Queen Rania Al-Abdullah Center for Environmental Science and Technology (QRACEST) at Jordan University of Science and Technology. This assessment team was subdivided into three teams each covering one aspect of the assessment. One group identified and investigated the large consumers and are referred to in this document as the "demand-side" team. A second team of researchers looked at prevailing conditions in the marketplace and the needs and concerns of suppliers, manufacturers and distributors. They are referred to in this document as the "supply-side" team. The third team examined the policy and regulatory environment that either inhibited or facilitated demand management and the installation of WSDs. That team is referred to as the "enabling conditions team". In addition, another team led by Marketing Research Organization (MRO), is in the process of conducting a social science assessment of knowledge, attitude and practices towards WSDs.

The sum of all findings by the teams indicates that the amount of potential water savings is enormous, almost 14 MCM if all 506 of the large consumers were to retrofit tomorrow. This sum is greater than the annual catchment of Mujib dam, one of the larger dams in Jordan. However the cautionary note is that retrofitting alone will be insufficient to sustain savings over time. The US experience in water conservation defines water conservation as sustained savings in water. The only previous experience in Jordan with water savings suggests that absent a detailed program to support WSD installation, savings may not last very long. This is not the fault of the device necessarily but attributable to a cluster of issues such as preventive maintenance training for maintenance staff, purchase and installation of devices suitable to the Jordanian context, and appropriate selection of buildings to receive the devices. Perhaps the most important finding is the need to begin as soon as possible on policy and regulatory incentives to encourage and facilitate the use of WSDs. Without these changes outlined in Chapter 8, water demand management and water conservation will remain an uphill struggle. Right now there are precious few reasons that would drive consumers to conserve and only too many reasons (primarily to do with unreliability of water supply) not to change the status quo.

The collective assessment team started by defining the large consumer in the Jordanian context. Discussions with LEMA (the consortium of firms awarded management of the Amman water utility) staff suggested that most of those considered large consumers in Jordan would not hold that dubious status were they not living in a water-deficit country. This definition was however, important since it then limited the potential universe of large consumers to be assessed. Consultation with USAID, the Water Authority of Jordan (WAJ), and LEMA, among others, finally provided a definition. Customers with a consumption rate exceeding 500 cubic meters per cycle (3 months) were classified as large water consumers. This is double the rate used previously by the Universal Engineering Consulting (UEC) study of 1995. A list of 640 consumers was identified by consulting the consumption rate lists provided by the MWI / WAJ and LEMA for the Greater Amman Area, and other cities of Jordan and contrasting these lists with the list prepared by UEC for the previous study. This list was further refined to exclude certain buildings such as military installations, and

buildings where security was an issue. The final number of buildings in the universe of public and private large consumers is 506, of which 224 are government entities. A representative sample of 58 large water consumers representing government buildings, schools, hospitals, mosques, industries, and universities was then studied in greater detail.

The demand-side survey revealed a tremendous variability in sanitary and plumbing fixtures in terms of type, make, and condition. This variability was observed from one building to another and sometimes within the same site. Variations in flow rates and water quality were also noted. Many of the toilets leaked due to scale and sediment in the water or due to manufacturing deficiency. All these factors indicate that future retrofitting programs should consider a comprehensive water audit for all selected sites before purchasing fixtures. In-depth water audits were conducted for two sites, as much to determine how much the cost of a full audit would be as to see what the conditions of two representative public sites might yield. The two in-depth audits were of Al-Bashir Hospital and the Ministry of Water and Irrigation offices. The first, Al Bashir Hospital, represents a large complex of buildings in varying states of repair and with an enormous volume of users for the available sanitary fixtures. It shows that the savings potential in such an establishment is enormous, but the condition of the buildings and the amount of repairs that may need to be done are also considerable. The second, MWI headquarters, represents a typical government building with both an old wing in poor shape and a new wing recently completed. These audit reports are available under separate cover.

An estimate of the anticipated water savings for different retrofitting alternatives were prepared for both public and private sectors. A total of 6.44 MCM saving is expected over the coming ten years if *85% of large consumers of public entities* are retrofitted with WSDs. If 25% of these buildings are retrofitted, a saving of 1.61 MCM is expected over the coming ten years. Among the different fixtures at public sites, retrofitting western toilets, urinals, and faucets presents the most water savings (consumption reduction rates of 2,144,613, 1,934,350, and 2,491,729 cubic meters respectively). Even greater savings potentials exist if a leak detection and repair program is simultaneously launched. Rough estimates are that 30% of all water use in these buildings is due to leakage. There are additional issues with public buildings that make the task difficult but not impossible, which are described in Chapter 6.

The supply-side team obtained lists of sanitary and plumbing suppliers (potential WSDs suppliers) from the chambers of commerce in Amman, Irbid, Zarqa, and other major cities in Jordan. These lists were evaluated and contrasted against a previous list used by Cartelle Associates in a 1996 study. A final list of 38 potential suppliers of WSDs was then identified and visited by WEPIA's supply team. This list included 15 retailers, 19 wholesalers and importers, and 4 manufacturers. Results of the survey indicated that 22 of these suppliers carry one or another kind of WSD or could provide it within one week (59%). However several issues came up with suppliers. In the years since the last WSD study, many imported fixtures now have WSDs inserted into them by the manufacturer, thanks to the increased awareness of water issues in the country of origin) and enter the country simply as faucets, and showerheads. This is certainly true of fixtures imported from the US and Germany where flow rates are regulated much lower than in Jordan. The vendors in Amman are unaware that they contain these flow restrictors and aerators and do not promote them as such, nor does Customs make exemptions for these items. Supplier ignorance as to what was considered a WSD is also linked to the lack of labeling on products, such that it is impossible to determine the capacity of toilet tanks, the flow rates of faucets and showers. There is also enormous diversity in quality in the marketplace, making it confusing for shoppers to determine what is good quality and what is bad. Nor do the vendors have the funds to promote their products and look to WEPIA or to

policy and regulatory changes to ensure them a steady supply of clients. And finally the suppliers also are limited by their incomplete understanding of the policies and regulations that govern their products. Chapter 5 discusses the findings of the "supply-side" team.

The enabling conditions team reviewed Jordanian legislation for any laws, regulations, codes, and policies that would promote or hinder the use of WSDs in Jordan. The set of legislation on water and environment was the principal focus of this search, but not the exclusive one. Several in-depth interviews with key personnel dealing with legal and water issues in Jordan were conducted. Other issues that were explored by this team had to do with the tariff structure on WSDs. The team concluded that current water laws, regulations and codes generally suggest water conservation, but there is no definition of what constitutes conservation and no specific requirements for the use of water efficient plumbing fixtures. The team also concluded that the absence of specifications and proper labeling of fixtures made it extremely difficult for even the most determined water conservationist to pick out a water saving fixture from the myriad of fixtures on the market. The lack of quality control regulations also allowed too many poorly manufactured (inefficient) fixtures to be sold. Because most of these are of local manufacture, their competitive edge means they are in demand by much of the general public continuing the spiral of leaks. The tariff policies are still unclear to some suppliers despite efforts by MWI in the past to reduce tariffs. And, finally, there appears to be no effective enforcement of penalties on water misuse, and no incentive programs for retrofitting old buildings with WSDs. Chapter 6 presents detailed recommendations of actions for policy and regulatory enhancement of water conservation in Jordan. Chapter 6 presents detailed recommendations of actions for policy and regulatory enhancement of water conservation in Jordan.

One aspect that emerged from this review of enabling conditions is the potential for cooperation that exists amongst the donors. Several donors provide funding for construction of buildings (e.g. the World Bank and Japan provide funding for the construction schools, renovation of hospitals), for economic development (e.g. the World Bank through the IFC supports the construction of hotels) and for other purposes, which have an impact on water use, but which are not considered in the program designs. Asking donors to place a small conditionality on how their loans or grants are used, would be most helpful. If, for example, the World Bank required all construction with its funds to include water savings devices, that would obviate the necessity of returning to those buildings some time later and retrofitting---a much more expensive proposition. If USAID required all new construction or renovation of clinic facilities or hospital facilities under its health program to include a requirement that they should also have WSDs, that would create synergy amongst USAID programs.

Post audits for seven of the buildings retrofitted with WSDs during the first study in 1996 were conducted. Findings from these audits indicate that few WSDs still exist; records of water savings were not kept; and many of these buildings changed function. The team suggests that these conditions are due to lack of educational, and training programs to the maintenance personnel and users; few follow up programs; and that perhaps, a better selection of WSDs could have been installed in the first place.

Several focus groups (round table discussions) for the government sectors, hotels, hospitals, and large industries were arranged. These meetings were instrumental in gathering and incorporating feed back from participants for WEPIA's programs and to gauge their willingness to use WSDs in their facilities. In general, the participants expressed a great interest in water savings and WSDs.

A fourth team took the results of the field surveys and analyzed the data. The team considered different retrofitting alternatives with different WSDs for 25% and 85% of the large public consumers. The cost for purchase, retrofitting, and maintenance was estimated for each option. The total cost to retrofit 25% of the public entities is considered to be approximately $1.01 millions and the cost for retrofitting 85% of the buildings is around $3.50 millions. The internal rate of return on WSDs is 53.00%. These costs are exclusive of costs for programs around retrofitting and also do not include management costs. This latter cost is estimated at between 10-20% in the US and more expensive in Jordan. Most management costs are fixed costs and so diminish proportionately with the number of buildings being retrofitted.

Cost per cubic meter of water saved ranges from $0.12 for showers to $0.74 for western toilet. Faucets present the largest water savings at a cost of $0.34 per cubic meter of water saved. For 85% retrofitting of the public sector, the estimated cost for saving a cubic meter of water is about $0.54 with a pay back period of 2.56 years.

If WEPIA were to be asked to install and fit WSDs into the public sector buildings there are other issues that need to be reviewed. The present staffing arrangement and the present skill mix does not allow for sufficient expert management and supervision of such a venture to take place. Administrative and management issues and program issues were not discussed in this document in great detail, because, unless the retrofit program is to take place they are moot. WEPIA is prepared to make a budget for these additional costs once funding is approved.

Perhaps the most significant finding of the study was the number of concerned and engaged individuals who wanted to do something positive in this sector. Time after time WEPIA staff and researchers ran into individuals such as the Head of Engineering for the Amra Hotel. This gentleman was persuaded some 5 years ago to purchase and install WSDs, and has been maintaining meticulous records since that time on the water saving his hotel has achieved. His experience he shares with other hotel maintenance engineers on a regular basis. At a small 2 star hotel in Aqaba, the maintenance man, with only on-the-job training, had rigged up a series of home-made water savings devices, calculated the consumption rate per client and monitored the water consumption of each part of the hotel. This, in a city that unlike Amman, has a continuous supply of pure water from Disi and where the Government is considering establishing a water theme park for the pleasure of tourists. At a parochial school in Aqaba, the principal of the school begged the research team to provide them with technical assistance so that they could conserve water. What they lacked, they said, was correct advice. The Assessment made it very clear --- there are many good and responsible people who are anxious to do the right thing given the correct incentive, information and support. This assessment is dedicated to them.

ACRONYMS

AED	Academy for Educational Development
AGWA	Amman Governorate Water Authority
BMP	Best Management Partners
CEHA	Center for Environmental Health Activities
DAI	Development Alternative Inc.
DST	Demand Side Team
ECT	Enabling Conditions Team
FOE	Friends of Environment
JUST	Jordan University of Science and Technology
JVA	Jordan Valley Authority
LEMA	Suez Lyonnaise Des Eaux
MCM	Million Cubic Meters
MRO	Marketing Research Organization
MWI	Ministry of Water and Irrigation
NGO	Non Government Organization
PBWC	Professional Business Women Club
QRACEST	Queen Rania Al-Abdullah Center for Environmental Science and Technology
SST	Supply Side Team
UEC	Universal Engineering Consulting
USAID	United States Agency for International Development
WAJ	Water Authority of Jordan
WHO	World Health Organization
WSD	Water Saving Devices
WEPIA	Water Efficiency and Public Information for Action
YEA	Young Entrepreneur's Association

STUDY TEAM

The assessment study team consists of professionals from several US and Jordanian institutions/companies all of which have a specific area of expertise:

AED is a US NGO with over forty years of development experience in public education and social marketing. AED pioneered efforts in all aspects of development communication, and for the last five years has been a leader in the provision of environmental education. AED's environmental work has taken place in over 23 countries working on such issues as water quality, water conservation, coastal resource management, forest management, urban issues and social issues.

BMP is a consulting firm based in the US. BMP specializes in water efficiency for residential and commercial sectors. Areas of expertise include: project design, cost -benefit analyses, project implementation, plumbing code amendments and project management.

BPWC-Amman was established in 1976 as an NGO affiliated with BPWC-International based in London. The honorary president is her majesty Queen Noor Al-Hussein. The mission of the organization is to promote the position of women in society. It encourages women to pursue business and professional careers by offering professional counseling, conducting workshops, seminars, and training sessions on a wide range of issues including legal consultation, business management, and small business start up and micro-enterprise.

Cartelle Associates was established in 1990 to support the industrial sector in Jordan with cost effectiveness studies and industrial and environmental consultations. Cartelle established an international network with sister companies in Australia, New Zealand, the United Kingdom, the United Arab Emirates, Syria and Yemen. Over the last ten years, Cartelle has performed more than 170 cost effectiveness studies and consultations to industries including chemical, pharmaceutical, food and beverages, textile, metal, plastics, and paints industries.

DAI brings 29 years of experience in the design, implementation, and evaluation of economic development and natural resource management projects. Since its founding in 1970, DAI has implemented more than 1400 projects in 138 countries. DAI's portfolio consists of 44 multi year projects, including 10 projects supporting water resources management objectives. The firm employs 441 U.S. and foreign nationals worldwide, including the Bethesda headquarters staff of 168.

QRACEST is entrusted with the mandate of participation in the national and international efforts towards attaining sustainable development by preserving the environment in an integrated manner that takes into consideration the economic growth factor through education, training, technical services, and research. QRACEST is the focal point for the regional network on the use of the Geographic Information Systems (GIS) in Environmental Applications. It is also one of the centers accredited by the Late King Hussein Environmental Management Training Program (KHEMTP) and is a founding partner of the Jordanian Network for Environmentally Friendly Industries (JNEFI).

YEA was established in 1998 as a non-profit organization in order to create outstanding young entrepreneurs through idea exchange, fellowship, education, training, and advocacy. YEA recognizes the important role young businesspeople can play, not only in increasing economic competitiveness, but in strengthening the basis of a free market economy.

The following are biographies of key members of WEPIA survey team:

Mona Grieser

Mona Grieser is the Chief of Party for the WEPIA project and brings over thirty years of development and managerial experience to her position. Ms. Grieser is considered amongst her peers to be one of the foremost communication and social marketing specialists. Prior to joining AED and WEPIA she was the owner of Global Vision Inc. a firm specializing in communication for the environment. The firm has important environmental contracts with several donor institutions and has won numerous international awards and recognition for the quality of their work. She has developed and implemented programs to train UNDP staff worldwide in environmental issues, putting together a global Master tTrainers program covering 143 countries. She was also the Senior Technical Adviser to the GreenCOM project, the largest USAID-funded environmental communication project in the world. She is responsible for providing technical assistance to and managing environmental programs as diverse as curricular reform in Mali and water issues in the Middle East under the Peace Process and designed and implemented programs in over 23 countries. She has worked in Jordan extensively since 1983, managing research and implementation activities in water .

Thomas E. Pape

Thomas Pape is the President of Best Management Partners and past Director of ViewTech US and Canada. He is considered to be amongst the foremost energy and water resource demand-side experts in the United States and Canada. His past work includes experience in financial and marketing analysis of water conservation activities of several large metropolitan areas in the US, the implementation of demand-side management programs for large municipalities including the cities of Los Angeles, Santa Cruz, Santa Monica, California and Austin Texas, all water deficit cities. He has been responsible for retrofit programs in San Diego, Los Angeles, Monterey, Alameda County and Santa Cruz, amongst others. He has performed numerous water assessments and audits, as well as evaluation studies of demand-side programs for large consumers such as hotels and hospitals. He has managed kit distribution programs, incentive programs, rebate programs, water savings audits and developed national and regional conservation programs. He is the Chairman of the American Water Works Association (AWWA) Interior Plumbing Committee, Charter Member of the American Environmental Engineer's Demand-side Management Society, and a Trustee of the AWWA, Conservation Division, the leading technical water association in the US. He has won several awards from his peers and from major utility companies for his work in water conservation. Mr. Pape is principally responsible for designing the demand-side survey activities and providing costs of retrofitting government buildings in Jordan.

Dr. Wa'il Y. Abu-El-Sha'r

Dr. Abu-El-Sha'r currently serves as the Director of the Queen Rania Al-Abdullah Center for Environmental Sciences and Technology at Jordan University of Science and Technology. As founder of the Center he enjoys the respect of his peers in the scientific and technical community of Jordan and internationally as a leading water specialist. His research includes working with government and donor agencies on a variety of water issues in industry, commerce and residential use. He and his staff have been actively engaged in performing environmental assessments, evaluations, looking at wastewater treatment programs, re-use programs, water pollution programs and use of water in industry. He is a member of several important Jordanian National Committees including Water Security and Water Quality. He has published extensively, is a leading scholar in his field, and has also mentored a number of excellent graduate students who have also participated in this study as field interviewers. He is a valued Director of programs sponsored by the Canadian

International Development Agency, the World Health Organization, The United States Information Agency collaborating with the American University in Beirut and Purdue University in the US. He is a graduate of the University of Michigan in Ann Arbor holding degrees in both civil and environmental engineering.

Dr. Richard M. Hailer
For over twenty years, Dr. Hailer has designed and implemented Water Conservation programs. His first project in 1979 in Massachusetts won a White House Award. As a consultant to universities, state government and national programs, he has developed educational programs for community conservation projects around the United States. He has assisted the Tennessee Valley Authority in Egypt and has consulted with the South Florida Water Management District for the past eight years on domestic and international water efficiency projects. Dr. Hailer has worked extensively on international programs in Canada, Latin America, Africa, Asia and the Pacific. For the past twelve years he has worked primarily in Egypt, on local development and water conservation projects and has conducted several projects in Jordan, most recently as a consultant with the Middle East Desalination Research Center.

Dr. Yahia Majali
Dr. Majali is an Assistant Professor at Jordan University of Science and Technology recently returning from ten years of experience working with US water engineering firms and water utility companies. Dr. Majali has had extensive experience with large scale water supply programs working on the water tunnel supplying New York City and Yonkers, New York. He has worked with the Massachussetts Water Authority in construction and modifications of their water supply system. He has worked with the US Department of Defense on groundwater modeling programs and with the US Environmental Protection Agency (EPA), the Department of Energy to develop industry standards. Dr. Majali also has considerable experience in water conservation, water re-use and water supply programs and shares that experience, adapted to the Jordanian setting with WEPIA.

Dr. Raoul E. Nasr
Dr. Nasr is an Assistant Professor at Jordan University of Science and Technology, specializing in agricultural economics, focused on water issues. Dr. Nasr received his Ph.D. degree in the US at the University of Illinois. He has extensive experience in econometrics, economic modeling, computer modeling particularly for environmental issues and is published widely in peer review journals in Jordan and the US. He has wide consulting experience in the US and in the region and is a valued member of the team. He has assisted the demand-side activities in this project and also focused on cost issues. He was principally responsible for the comparative financial analysis for the project and supervised the cost-benefit analysis team.

Mr. Fraser Parsons
Mr. Fraser Parsons is a Canadian engineer with over 19 years of experience in the field of operation, management and development of public utilities, specifically water utilities. His work with a large Canadian utility included conservation program management, demand-side management, supervision of metering, and customer services. His efforts in Canada and the US include toilet replacement programs, installation of water savings devices in municipalities, and development of standards for water savings devices. He is considered a leader in this field internationally. Mr. Fraser Parsons has extensive Middle East experience and served in 1999 as a consultant to Lyonnaise des Eaux, (LEMA) in the design of their water conservation program for Amman. Mr. Parsons has served as a water consultant in Cairo, Egypt working on the Canal Cities Project, was responsible for the Operations and Maintenance Team, and currently serves as a Commercialization Specialist

for the Middle Egypt Utilities Project for Harza Corporation. Mr. Parsons was invited by WEPIA for a special consultancy to assist in the design of the Assessment survey.

Mr. Hassan Abdoo
Mr. Hassan Abdoo is the President of Cartelle Associates, a marketing and engineering consulting firm based in Amman but working regionally. Mr. Abdoo served as the principal researcher for a study of water savings devices prepared by Universal Engineering Consulting Group completed in 1995, and funded by USAID. Mr. Abdoo has worked with the supply-side since that time and led a team of researchers to thoroughly review the market.

Ms. Hanan Mohammed Ahmed Al-Quennah
Ms. Al-Quennah is a successful practicing lawyer in Amman and a member of the Business and Professional Women. She has extensive experience in public policy and assessment and was specifically focused in the WEPIA survey on the enabling conditions for improving the policy and regulatory climate for the use of water saving devices in Jordan. She is currently serving as Head of the Legal Department of the International Investment Arabian Group. Ms. Al-Quennah worked closely on this assignment with Ms. Liana Brooks of the US State Department, a specialist in governance and policy issues.

Mr. Abdus Salaam Rajai Kamal
Mr. Kamal is a geologist and engineer with extensive experience in water savings devices. He served with a USAID team in 1994-98 as a water specialist working with the Jordan Environment Society and the Ministry of Water and Irrigation and was responsible for the installation of water saving devices in nine pilot demonstration sites in Jordan. He has been a principal investigator in several field-based research activities including managing a USAID behavioral study twice on awareness of water saving devices as well as conducting a market survey of water saving devices in Jordan and the US markets. Mr. Kamal coordinated the field data gathering of all customer groups in the survey.

Mr. Raouf Dabbas
Mr. Dabbas is a civil engineer with considerable experience in water conservation both as an advocate through his work as President of the Friends of the Environment, and through his personal work as the owner of a water products enterprise. Mr. Dabbas is very familiar with issues and constraints facing the suppliers, manufacturers and distributors of water saving devices in Jordan.

Ms. Nadia Sammour
Ms. Sammour is a civil engineer specializing in water and the environment and a graduate of Jordan University of Science and Technology. As a consultant with WEPIA she brings extensive experience in private sector consulting and with the Ministry of Water and Irrigation. She has served multiple essential functions at WEPIA providing and briefing technical staff and consultants on previous studies in the field of water saving devices in Jordan, liaising with the Ministry of Water and Irrigation and serving as a field adviser and senior researcher.

Mr. Raed Al-Nimri
Mr. Al-Nimri is an environmental engineer and a graduate of Jordan Universtiy of Science and Technology. He has had extensive experience in reviewing environmental standards at several Jordan industrial sites as an intern with the General Corporation for Environmental Protection. As a member of the WEPIA survey team he has been reponsible for data collection and preparing statistical reports for both the Supply and Demand side teams.

The following list presents all members of the assessment teams and their affiliation and tasks:

Mona Grieser	Chief of Party	AED
Richard Hailer	Sr. Technical Specialist	AED
Nadia Sammour	WEPIA Coordinator	AED
Fraser Parsons	WEPIA Consultant	AED
Rana Muhtaseb	WEPIA Admin. Assistant	AED
Hanan Al-Quennah	Legal Consultant	BPWC
Hassan Abdoo	Supply Side Survey Leader	Cartelle
Raouf Dabbas	Supply Side	DAI/FOE
Thomas Pape	Project Consultant	DAI/BMP
Abdus-Salaam Kamal	Demand Side	DAI
Lubna Awwad	Adminstrative Assistant	DAI
Wa'il Abu-El-Sha'r	Document Control	JUST
Raoul Nasr	Economist	JUST
Yahia Majali	Demand Side Leader	JUST/AED
Motasem Al-Haddadin	Graduate Student/ surveyor	JUST
Raed Al-Nimri	Graduate Student/ surveyor	JUST
Omar Al-Qudah	Graduate Student/ surveyor	JUST
Ehab Al-Quran	Graduate Student/ surveyor	JUST
Eyad Batarseh	Graduate Student/ surveyor	JUST
Randa Hatamleh	Graduate Student/ surveyor	JUST
Eihab Qiblawi	Graduate Student/ surveyor	JUST
Emile Cubiesy	Marketing Issues	YEA

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Chapter 1
INTRODUCTION

1.1 Purpose

Water scarcity has been a perennial problem for the Hashemite Kingdom of Jordan exacerbated in recent years by an unrelenting drought that is affecting the entire region. While water resources in the region are constrained, demand for water has increased and outstripped supply, due to rapid population growth, economic and agricultural growth and affluence among certain cadres. The water supply crisis in Amman in the summer of 1998 reinforced the importance of water issues to the government and public alike. The response to this problem by the government of Jordan has been to look for both conventional and non-conventional ways to increase water supply, and to promote efficient uses of available resources for domestic, agricultural, industrial, commercial and other purposes. For domestic users, the MWI recommended either water harvesting from the roofs of buildings or the use of Water Saving Devices (WSDs). Similarly for the large consumers in industry, commerce and the Government itself, WSDs were recommended.

WSDs are simply defined as the diverse methods employed to emphasize water savings and water efficiency without jeopardizing convenience to the end user. Among these definitions, three are listed below:

USAID defines WSDs as "those devices which are installed in the facility at the points where there is water consumption such as mixers, faucets, wash basins, sink taps, shower heads, toilet flushes … etc. in order to reduce the consumption rate in a way that is convenient to the users."

The MWI defines WSDs as, " devices that can be installed on faucets, mixers and toilet tanks which minimize the amount of consumed water or the duration of flow without effecting the nature of using it and its efficiency and these devices can save between thirty to fifty percent of consumption even sometimes sixty percent in the case of water saving washing machines."

A leading Jordanian supplier's definition of a WSD is "any device that improves the water efficiency of the appliance while still giving comfort".

Thus WSDs, for the purpose of this study, have two characteristics. They have the ability to save water, but do not require the behavioral compliance of the end user. In fact the end user may rarely be aware that his fixtures have WSDs installed. Behavioral considerations are still important, but in other ways as the study will show.

Saving water, besides contributing to improved demand management of water in Jordan, also provides a direct financial savings to the consumer either in

reduced water bills, or a reduced rate of waste water, as well as indirectly in saving energy as a result of hot water savings. In a previous study on the use of WSDs in Jordan, certain WSDs were installed by the Jordan Environment Society (JES) in 1996 at different sites, (households, hospitals, hotels, schools, universities, businesses). The assumed total water savings of these sites varied from 16-33% depending on operational conditions at each site.

In January 2000, USAID/ Jordan funded, **the Water Efficiency and Public Information for Action (WEPIA**) program under its strategic objective of Improved Water Resources Management. In addition to its primary goal of assisting Jordanian NGOs to improve and expand public education on the water shortage situation in Jordan, and promoting ways in which individuals and public and private sector institutions can conserve and more effectively manage scarce water resources, WEPIA is also tasked with realizing a significant increase in the number of public and private buildings that install water saving devices. As stated earlier these other technologies could include the collection of rainwater for reuse, or gray water re-use. More specifically, the anticipated results for WEPIA include:

"WSDs installed in 85% of the hotel industry, 85% of the private hospital industry, 70% of private schools, and in 50 large private businesses.

WSDs installed in 85% of large water consumer public entities e.g. ministries, government hospitals, universities and schools.

WEPIA was mandated to conduct a major assessment of the WSD sector in the first six months. This report summarizes an assessment of the context in which the above results can be obtained. Included in the contextual assessment are the promotion and best use of water saving devices in Jordan, and estimates of the cost of procuring, installing, and maintaining the WSDs needed to achieve these results.

1.2 Scope of the Study

In recognizing the complexity of issues around the widespread adoption of WSDs and the challenge of achieving the anticipated results listed above, WEPIA has conducted an assessment to address many issues in addition to the cost estimate for such devices. In March 2000 WEPIA assembled a multidisciplinary Assessment Team that was responsible for completing four principal tasks:

Task A. Examining the factors that effect the supply of WSDs in Jordan.
Task B. Reviewing the potential for increasing demand for WSDs in Jordan.
Task C. Reviewing the enabling conditions, such as policies and incentives, for increasing WSD demand while ensuring supply.
Task D. Preparing a cost estimate for USAID/Jordan of the purchase price of WSDs by USAID to retrofit major public and private sector buildings, installations, and facilities.

The Assessment Team was divided into three teams Supply Side Team (SST), Demand Side Team (DST), and the Enabling Conditions Team (ECT)), consisting of a combination of U.S. and Jordanian professionals. Several of WEPIA's Jordanian NGO partners provided technical staff that

participated to differing degrees in the assessment process. In addition, a Presidential Management Intern with expertise in Middle Eastern policy and water issues participated at the request of USAID/Jordan. JUST provided graduate students specialized in water resources and environmental engineering to conduct the field surveys.

As intended by WEPIA staff, the assessment process itself served a dual role. Firstly it served to train Jordanian participants in how to work collaboratively to acquire accurate information. Secondly it served to motivate and rally potential clients (hotels engineers, hospital engineers, construction industry representatives. etc…). In other words the study itself became a social marketing tool. Implicit in the cost estimates for WSDs is that they would be purchased in the US by USAID. Where better brands or varieties are obtainable in other countries these are also noted.

1.3 Document Organization

The document is organized as follows:

Chapter 1 introduces the project, outlines the scope of the study, and presents the study strategy.

Chapter 2 is an overview of the water saving devices sector including study justification, activities, methods, and constraints. And it reviews demand for water in Jordan through examining previous studies, defining criteria for large water consumers and creating a universe of large consumers. The demand-side assessment also performed a rapid water audit of a sample of the large water consumers to determine their current state of fixtures and to enable the study team to estimate costs for retrofitting them.

Chapter 3 reviews available WSDs in the US and explores the potential use of these in Jordan.

Chapter 4 sets the prices for the proposed activities.

Chapter 5 presents a thorough summary of the assessment of the suppliers, manufacturers and distributors of WSDs in Jordan-pricing, placement and positioning.

Chapter 6 reviews existing policies, specifications and regulations that may affect WSDs and examines the possibility of drafting new pieces of legislation to promote the usage of WSDs.

Chapter 7 reviews the post audit results of the buildings that were retrofitted with WSDs in 1996 and summarizes the lessons learned.

Chapter 8 provides the conclusions and recommendations of the assessment study with emphasis on the approach and cost alternatives for retrofitting WSDs in Jordan.

Chapter 9 discusses some of the management and administrative issues associated with retrofit programs.

Appendices contain all necessary information pertinent to this study.

Chapter 2
DESCRIPTION OF THE ASSESSMENT OF THE WATER SAVING DEVICES SECTOR

2.1 Rationale

WEPIA is concerned with water demand management, specifically promoting the widespread use of WSDs in Jordan. Previous experience with the use of WSDs indicates that, on average, a saving of one-fourth to one-third in water consumption rates is expected with a cost recovery period of less than three years. This is in line with the findings of two workshops on Water Conservation and Reuse (that were held in Amman in March 1996 and April 1999) organized by the World Health Organization (WHO)/ Eastern Mediterranean Regional Office and its Regional Center for Environmental Health Activities (CEHA) with participation from 15 different countries. The results of that workshop demonstrated that conserving water is more cost effective than expanding water supplies to meet increasing demand.

WSDs are still uncommon in Jordan for a variety of reasons that include the lack of awareness about these devices; concerns regarding convenience, cost, and public health; the variability in water pressure and variability in sanitary fixtures; the availability of WSDs at local suppliers; and finally, lack of demonstrable success in previous water conservation projects. In addition there are sociological reasons that hamper efficient water conservation measures, the most important related to the unreliability of water supply, and the low cost for water.The extent to which each of these factors limit the widespread use of WSDs is not fully understood. To address these factors and others, WEPIA launched this assessment study on WSDs in Jordan.

Short and long-term programs have been designed into WEPIA to increase public awareness and action on the individual's role in reducing demand on scarce water resources and on the role of WSDs to create more efficient systems once water supply reaches their place of work or residence. Short-term strategic programs have been designed to create accelerated and immediate impact on water shortage issues. These include water audits and leak detection programs that engage a wide swath of the young population, women and other adults; use of mass media to communicate pertinent, actionable messages; and linkages with other programs to inform and educate the public about the water systems in their places of work and their residences. For the long-term, WEPIA is targeting children, future water consumers, through an integrated curriculum that incorporates accurate information about the Kingdom's water resources. Attempts to incorporate these concepts in university offerings are also planned. All these efforts are in collaboration with the Ministry of Water and Irrigation and with the appropriate, relevant Ministries of the Government. Implementation of these programs is through the diverse NGOs that deal with environmental or water issues.

Two studies were therefore commissioned under WEPIA. The first study concentrates on the sociological, psychological and systems/organizational factors that inhibit adoption of water savings devices by the various target groups in which WEPIA has interest. This study was awarded to a market research firm, MRO. A second and much larger study, the one reported in this document, focused on structural concerns that might inhibit adoption of water savings devices. These included examining fixtures, pipes, flow rates, pressure, age and condition of the building and other intra-site factors. It also examined issues common to all sites—the cost and availability of WSDs, the appropriateness of the ones available in Jordan; manufacturer's concerns, policy concerns and other

related issues. Because the population of Jordan, on average, is already amongst the world's lowest consumers of water, (often approaching levels of consumption that WHO associates with public health concerns), WEPIA primarily focuses on the large water consumers in the nation. Concerns regarding convenience and public health therefore are managed by targeting large water consumers with consumption rates above 500 cubic meters per cycle. With such rates, the water poverty level is unlikely to be violated.

2.2 Scope of the Study

WEPIA assessment teams reviewed factors affecting the manufacture, sale, importation, usage, costs and reliability of WSDs for residential, commercial, industrial and public sector use in Jordan. The team also studied the present regulations, laws, policies and practices that either promote or hinder the widespread usage of WSDs.

The team reviewed existing literature and conducted sample surveys, individual interviews and focus groups with key agencies, individuals, and institutions in Jordan representing government, hotels, hospitals, restaurants, commercial establishments such as banks, and industries.

More thorough descriptions of the tasks are provided in the following sections:

2.2.1 Task A. Examined the factors that effect the supply of WSDs in Jordan *(The Supply Side Team)*

The mission of the Supply Side Team (SST) provided WEPIA staff with the critical information and recommendations that served as the cornerstone of its strategic plan to achieve many of the anticipated results listed in chapter 1. This team included, among others, plumbing industry experts who assessed the capability of the local plumbing industry to produce, import, distribute and market high quality, appropriate WSDs and auxiliary fixtures in Jordan. More specifically, the SST was responsible for assessing the following:

2.2.1.1 Water Pricing

SST outlined the pricing of potable water in Jordan (both private from water tank sales, and Government) and examined ways to introduce user-pay principles to components of the existing water tariff. This required investigating the potential for adjusting surcharges related to particular service regions, the reliability of service, and the volume of the customer's water storage.

SST also assessed the effect of import tariffs on the cost and availability of WSDs in Jordan, including those devices that are currently recommended by the MWI and other key water authorities. This was accomplished through interviews with Jordanian industry representatives from retail, wholesale, and manufacturing sectors.

2.2.1.2 Product Identification

The team inspected the local retail plumbing market and reviewed the makes and models of plumbing fixtures (end-use fixtures) that are most commonly sold in the Jordanian marketplace.

SST reviewed the list of U.S. manufacturers of WSDs as prepared by the Southwest Florida Water Management District and other Water Authorities in the U.S, Germany, and other countries with a history of water conservation. The team also checked "Consumer Reports" for efficient plumbing products and prepared a short list of the top rated plumbing fixtures (performance, price and consumer satisfaction) in each category (faucets, shower heads, toilets). This list identified manufacturers that presently have their products imported into Jordan or which Jordanian importers indicate they are able to import under their existing import arrangements with foreign suppliers.

The list served as an informational resource for plumbing retail companies and other importers in Jordan. SST recommended a short list of water savings devices for submission to MWI and for coordination with Jordanian customs officials. (This list reflects recommendations solicited from the Jordanian retail/wholesale sector since decision-makers in this sector know which products can most readily be made available in Jordan).

The following information was collected under Task A and is presented in subsequent sections:

- The cost of water for residential, commercial, industrial, agriculture, and other sectors.
- The various service charges, taxes, wastewater charges, time payments, etc., that comprise the overall water bill charged to water customers.
- The major manufacturers of plumbing supplies (china, brass, stainless steel, pipes, faucets, shower heads, irrigation equipment, etc.) in Jordan and the companies that manufacture WSDs.
- The major importers and distributors of plumbing supplies, WSDs, sources and types.
- The taxes and tariffs on imported plumbing supplies.

2.2.2 Task B. Review the potential for increasing demand for WSDs in Jordan *(The Demand Side Team)*

The Demand Side Team (DST) was responsible for assessing the following:

2.2.2.1 Previous Retrofit Project

The first activity was to examine performance (i.e., success and failure) of the nine sites that were fitted with WSDs as a component of the earlier Universal study and JES promotion with large water consumers. Members of WEPIA's assessment team visited seven of these sites, (two were not accessible), located and interviewed personnel at each site who were involved in the previous retrofit project, identified the fixtures that were retrofitted with WSDs, and verified the existence of these devices. For the existing WSDs, the contact person at each site was asked about the records of savings, performance, and their observations regarding these devices.

2.2.2.2 Construction Licensing Opportunities

The team investigated the existing licensing procedure for new construction. This included determining whether any requirements for building contractors currently exist that require achieving a certain standard for efficient water use.

2.2.2.3 Water Customer Consensus

The DST assessed the potential for encouraging the development and future expansion of the local supply and marketing of certain types of efficient water-use fixtures. This was accomplished by consulting small business owners/entrepreneurs such as hairdressers, laundries, and restaurants with known high water consumption rates to assess the market potential for water-efficient fixtures used by these and other customer sectors of the water utility.

The following is a summary of information collected under task B:

- Lists of the largest water consumers, both private and public entities.
- Prevailing conditions of the sites that were retrofitted with WSDs by JES in 1996.
- Data on plumbing conditions at sites of the largest water consumers.
- Estimates for the potential for significant water savings in high-water-use buildings.

2.2.3 Task C. Reviewed the enabling conditions for increasing WSD demand while ensuring supply *(Enabling Conditions Team)*

The Enabling Conditions Team (ECT), reviewed the policies of different governmental organizations that can influence the demand for WSDs. Private sector associations such as the Engineers Association and construction syndicates were also included in the review. More specifically, the ECT was responsible for the following:

- Inquiring if there are presently, or have ever been, any marketing promotions of efficient plumbing in Jordan.
- Assessing the needs of the plumbing industry for additional information about efficient plumbing codes and standards.
- Assessing the needs of Jordanian plumbing industry members for information about the makes and models of efficient plumbing products.
- Determining the interest of the plumbing industry in conducting marketing promotions of water-efficient plumbing products.
- Soliciting the names of other individuals and companies in Jordan that the team could contact.

2.2.3.1 Present Plumbing Codes and Guidelines

The effect of current Jordanian codes and regulations upon the promotion of WSDs was also identified. In those countries where significant water conservation programs have been achieved, they were generally accompanied or preceded by changes in policy, construction codes, tarriffs,

incentive programs etc..The team examined those local engineering and construction standards and specifications to identify models and recommendations for implementation.

While the role of import tariffs upon the availability of WSDs in the Jordanian marketplace has been investigated by the Supply Side Team, the Enabling Conditions Team has concurrently looked at this same issue and solicited the opinions of the Jordanian plumbing industry decision makers regarding how the tariff issue should be approached. Options for streamlining the importation process has been considered.

The following is a summary of information collected under task C:

- Government policies in MWI, JVA, and the Ministry of Public Works that act as barriers or incentives for WSDs use in Jordan.
- Current plumbing or building codes that affect the use and installation of WSDs.
- Licensing procedures for new construction and new businesses.
- Identified customs duties and sales taxes that are barriers or incentives to the importation of WSDs.
- Identified the processes by which rules, regulations, codes and standards are established.
- Effects of the policies of WTO, ISO, etc., on the growth of WSD importation and manufacturing in Jordan.
- Plans of LEMA for the use, promotion and institutionalization of WSDs.
- MWI programs to support use of WSDs for water conservation in general.
- Potential role that WEPIA can provide to complement and support their efforts.

2.2.4 Task D. Prepared a cost estimate for USAID/Jordan of the purchase price of WSDs to retrofit major public and private sector buildings, installations, and facilities.

Selected members of the team prepared an itemized list of the types, quantity, and costs of the various WSDs needed to retrofit a variety of major public buildings, installations, and facilities. These were initially for 85% of large water users of public entities. At the request of the Ministry of Water and Irrigation, figures were also determined for achievement of 25% installation. Accuracy of the estimates is approximately 98%. In addition, the costs for retrofitting with different types of WSDs were estimated.

Details of the methodology, criteria, boundaries of each of these tasks are presented in details in the coming subsections and chapters of this assessment report.

2.3 Previous Studies/Review of the Literature

Several discrete studies informed this Assessment task and will be referred to throughout the document where appropriate. In 1996, a study of WSD use in Jordan examined the availability of WSDs in the U.S. and Jordanian market and tested its performance at selected sites in Jordan. The study was requested by the MWI and conducted under the auspices of the Water Quality Improvement and Conservation Project, funded by USAID/Jordan. Universal Engineering Consulting of Jordan conducted the study and installed WSDs in nine demonstration sites in collaboration with the Jordan Environmental Society (JES) under contract to Development Alternatives Inc. (DAI).

In April of 1997, Forward (a regional project also funded by USAID) joined with the MWI and WAJ to develop a work-plan for the analytical and Policy Tools for Costing and Tariffs Program. Although, the study provided clear indications of customer attitudes (residential and non-residential subscribers are willing to pay more for water if network supplies and services improve), it is less revealing about the actions that WAJ must take to gain some measure of customer confidence. The most supportable recommendations are those, which use the study's results as the basis for further exploration and design of customer relations and public awareness programs.

Other ongoing work in Jordan related to water conservation included the preparation of a water conservation plan for the AGWA. LEMA was responsible for preparing this plan as part of a World Bank-Funded contract for management of AGWA. The water conservation plan proposed the establishment of a "Water Demand Management Team" within AGWA to develop a partnership with the Jordan plumbing industry for promotion of "Efficient Water-Using Plumbing Products" within various customer sectors of the water utility. The Assessment was unable to access a final copy of this document, prepared by Fraser Parsons, but was informed by Mr. Parsons of its principal recommendations and findings, when he served as a consultant to WEPIA.

In 1995 GreenCOM, a centrally-funded USAID project, working with RSCN on water behavior, noted through their own research, that while Jordanians in actuality used less water than most countries in the world this was less due to appropriate water-conserving behavior on the part of Jordanian citizens than due to municipal cuts in supply. It noted that fixtures (toilet tanks, toilet bowls, bathtubs etc…) were the same size as those manufactured for more water-affluent societies such as the US and in many cases exceeded them. In addition they noted that the behavior of affluent Jordanians and the perceptions of those aspiring to affluence was closer to European and American perceived models in their water needs and behaviors (washing machines, dishwashers, pools), than what the regional environment would expect.

2.4 Methodology

2.4.1. Definition of a Large Consumer

In defining "Large Water Consumers" the MWI, WAJ, USAID, LEMA, and the WEPIA team determined the minimum amount of the average water consumption, per quarter per subscription. This threshold was used as a criteria to select the sites that comprised the universe. There were many propositions in this respect among which are the following average quarterly consumption (in cubic meters): 250, 300, 500, and 1000. However, there was a common agreement among the parties concerned that the average quarterly water consumption of more than 500 cubic meters shall define "Large Water Consumers".

2.4.2 Large Consumers Universe

In order to determine the total number of the large consumers, MWI and WAJ provided the assessment team with lists of WAJ subscribers of the different Governorates of Jordan of more than 300 cubic meters of water consumption for the last quarter categorized by function in each Governorate.

LEMA also provided the team with a list of subscribers of more than 500 cubic meter average quarterly water consumption for the last eight quarters as well as another list of subscribers of more than 250 cubic meters average quarterly consumption in order to avoid the summer of 1998 water supply and quality crisis. During that summer supplies from the Zai Water Treatment Plant were discontinued for long periods, and major parts of Amman were badly affected. People stopped drinking and using network supplies and turned to tanker and bottled water to fill basic requirements. Since then, MWI and WAJ have launched a major rehabilitation program in Amman to improve the distribution network and the services provided. On the other hand after WAJ raised the water tariff, large private sector users (i.e., hotels, hospitals, schools, and universities) started depending heavily on tankers.

The Demand Side Team (DST) reviewed the lists provided by MWI, WAJ and LEMA and was able to select 506 subscribers of quarterly consumption of more than 500 cubic meters out of which 224 were public sites and 282 private sites (Appendix, A-1, A-17).

However, the following large consumers were excluded:

- Individuals (Domestic Use) with large Consumption.
- Military Sites (excluding Military Hospitals), Public Security, Civil Defense
- Amman municipality Subscriptions (Excluding City Hall, Public WC's, Slaughterhouse and Public Library).
- Embassies
- Royal Palaces

2.4.3 The Representative Sample

While determining the total number of the large consumers (The Universe), the DST was able to select 58 sites (Table 2.1) as representative samples of the total "Universe". The criteria used to determine the selected sample were as follows:

- Those within the sample had to be similar to other large consumers in terms of function, water consumption, state and size of premises, number of sanitary facilities and number of users of those facilities;

- Those sites within the sample should represent the average of similar buildings in the universe rather than the extreme; and

- A very few sites were selected because they are unique, but in terms of water consumption very important. One such site is the King Hussein Medical Center, a vast complex of buildings that consumes very large amounts of water. However, because

King Hussein is a military site and therefore excluded from receiving USAID support, El Bashir Hospital was substituted for it.

Besides these general criteria through which the Assessment sample was drawn, a more specific functional criteria for each target sector was also implemented. Often the criteria were assigned weights, the weights totaled and the building with the median total selected to represent a cluster of similar buildings.

Table 2.1 Representative Sample of the Universe and Criteria for Selection.

No.	Sector	Criteria	Description
1	Hotels	Number of stars Number of rooms Avg. No. Of occupied rooms Building age No. And kind of facilities at the hotel Location	Four main hotel categories (Stars) were used as listed by the Department of Tourism. In addition for each category of hotel sub-categories that determined no. of sanitary facilities and no. of users was extrapolated. Hotels generally have a rough estimate of water consumption per occupied room. These rates vary by Star but included in the rates are multiple functions such as kitchens, laundry, employee use of facilities.
2	Hospitals	Avg. No. Of occupied beds Number of buildings age of building Standard of services Technology used Number of patients Number of employees Specialization	Since both private and public hospitals exist in Jordan, these were the principal categories under which several sub-categories were developed. Some hospitals cater to the affluent only, and their expectation of water use resembles a five star hotel. Other public hospitals have similar consumption levels but most often due to neglect and lack of maintenance. Ministry of Health provides standards that were helpful in determining the sample.
3a	Schools *Public*	School class level (comprehensive, secondary, basic, elementary) Gender (girls, mixed, boys) Function (vocational, academic) Location School constructed area School total area	The Ministry of Education and certain donors who support school construction e.g. World Bank have assumptions and criteria they use in school construction. These were used to determine number of students, number of sanitary facilities etc…These breakdowns were further classified into sub-categories by function, by sex of students etc…
3b	Schools *Private*	Number of buildings Estimated total constructed area Estimated total school area Estimated number of students	Private schools are simpler to characterize than public schools as they are better known and records more easily obtainable. The private schools are organized into four categories assuming each school category would have the same number of water outlets and water fixtures as the representative sample of that category.
4	Mosques	Total area Estimated number of prayers, visitors and facility users Total number of water outlets having	Mosques in Jordan are not homogenous nor are they all large water users. They are constructed through individual generosity in which size may differ considerably from mosque to mosque, or by fiat. Mosques in Jordan are supported by the Ministry of Awqaf which pays for their water and energy

		wc's Location Luxury	bills. WEPIA divided mosques into three distinct categories. King Abdullah Mosque falls into a category on its own as a unique site. It is the largest mosque in the country. The second category also hosts a unique site, Al-Hussein Mosque, the oldest in Amman in which there are no bathrooms at all. The third category comprises all the rest of the mosques. WEPIA assigned a standard number of facilities per mosque based on no. of worshippers and selected a median mosque for its sample.
6	Banks	Total constructed area Estimated number of users	Two categories: the first are two well known buildings in Amman, the Arab Bank and the Housing Bank, the second comprises the rest of the group in the universe.
7	Factories	Line(s) of production Total constructed area Plant total area Location Estimated total number of employees	Industries of the same production lines or production specialty have similar numbers of water outlets and water fixtures. In this target group there are representative samples of the five categories of industry: Pharmaceutical, Dairy, Beverage, Construction, and Fertilizer. WEPIA was unable to deal with water reduction in the manufacturing process but noted that this will have to be addressed in later activities. Thus only industries with large numbers of employees and therefore high bathroom use were included. Some industries also included extensive residential complexes for workers and these too were taken into account.
8	Restaurants		This target group has only one category since restaurants of large water consumption have similar numbers of water outlets and fixtures..
9	Commercial Companies	Total constructed area Number of buildings Age of building Estimated number of users Function Location	Since all the large users in this group were relatively similar WEPIA, weighted each criteria for each building and used the median building to represent the site.
10	Universities	Total constructed area Total number of buildings Campus total area	Universities having similar campus area and buildings, and similar numbers of students were assumed to have a similar number of water outlets and water fixtures. Using these criteria, the target group, as well as the representative

		Number of faculties Number of students Number of employees Age of buildings Location	sample, are categorized as Large Campus and Medium Campus Universities. Since it was impossible to assess all buildings in large complexes, WEPIA concentrated on those buildings where it was assumed sanitary facility use was heaviest e.g. dormitories. University Hospitals were placed in the "hospitals" category rather than in the University category.
11	Junior Colleges	No. Of students No. Of facilities No. Of faculty No. Of employees No. Of buildings	An assumption was made by WEPIA's teams that junior colleges were relatively similar in size, function, no. of students and no. of sanitary facilities. Thus all the junior colleges fell into one category.
12	Government Buildings	Total constructed area Total number of buildings Age of buildings Function Estimated number of users Location Water consumption levels	Governmental buildings fall into a number of categories. Eight categories were determined. Buildings within each category have similar number of water outlets and water fixtures, similar nos. of employees in buildings. The great diversity of governmental buildings made categorization extremely difficult. They ranged from the Port Authority in Aqaba which itself has numerous complexes and functions to such buildings as the headquarters of Awqaf. Water consumption also ranged considerably among these buildings.
13	Greater Amman Municipality	Total constructed area Number of buildings Total site area Function Location Estimated number of users	Three categories were selected based on Amman City Hall, Amman Down Town Public WC's and Amman Public Library.

Chapter 3
EXISTING WATER SAVING DEVICES OF THE USA

3.1 Preface

There are several factors of Jordan water use that are not typical of water use in the US. Before transferring water conservation technology, strategies or products from the US, it is imperative to remember that local conditions may affect: water efficiency, lifecycle of products, public acceptance, and performance. Some of these factors are:

1. A high level of TDS contained in the water, which causes scaling (mineral build-up)in fixtures and pipes.

2. A large amount of sediment flows with the water into plumbing fixtures.

3. Water pressure varies greatly, but is often very low (1 bar).

4. Plumbing fixtures and fittings are not as standardized as in the US.

5. Low water availability and high cost have coerced Jordanians to conserve water, and use plumbing fixtures differently than typically used in the US.

3.2 Replacement Toilets

3.2.1 Existing Conditions

The toilets in Jordan are a myriad of brands, styles, country of origin, sizes, and designs. Performance and efficiency is equally mixed. Turkish toilets are more numerous than western toilets in public and government buildings. Western toilets are usually tank-type, gravity design, and often use a flush activator located on the top of the tank lid. Some new toilets use a tank located behind a panel inside the wall. Though some flush-o-meter (tankless) type toilets exist, poor and variable water pressure often excludes the use of flush-o-meter type toilets. Most Turkish toilets are flushed by the use of a small water pitcher filled at a tap inside the stall, some use a flush tank mounted high on the wall. Since there are no US products for Turkish toilets, the following discussion in this section will only refer to western toilets.

3.2.1.1 Gravity Tank Type Toilets

Given the hard water conditions, there is no doubt that many toilets leak. Most toilets in Jordan use between 6 to 15 liters per flush. In response to water availability and high prices, some tanks have tank displacement bottles and/or lowered water levels to reduce flush volume.

The largest local toilet manufacturer (Jordan Ceramics Industries Co.) has reduced tank volumes in their toilet design, but has not correctly re-engineered the bowl to properly perform using only 6

liters per flush. Bowls and their trap-ways, designed to flush 15+ liters of water, do not efficiently flush waste using only 6 liters of water. The result is that toilets flush so poorly, people often do not place toilet paper in the bowl.

It appears most toilets are secured to the floor by bolts. All American made toilets are designed to be secured by bolts attached to the waste flange. Jordan made toilets do not have consistent placement of holes in base of bowl for attaching to floor. Any replacement of Jordanian toilets with US products may require the resetting of anchor bolts in the floor.

3.2.1.2 Flush-o-meter Type Toilets

In Jordan, flush-o-meter type toilets are plagued by two problems. Sediment in the water interferes with the valve closing properly, and variable water pressure causes the valves to open when the water pressure drops to zero and remains open even after the water pressure is re-established. Flush-o-meter valves were designed for US conditions, where water quality includes less sediment and pressure rarely falls below 1 bar (15 psi). Filters can be installed to screen out sediment, but the valve opening at zero pressure remains problematic.

There are two types of flush valves for Flush-o-meter toilets. One type uses a diaphragm to regulate water flow. The diaphragm relies on water pressure to close the valve, when water pressure drops to zero, the valve opens. Another type uses a piston to regulate water flow, which does not rely fully on water pressure to close and is less likely to open unless manually activated.

3.2.2 Potential Replacement with US Products

3.2.2.1 Gravity Tank Toilets

The manufacturers in the US have made several design changes in gravity tank toilets to achieve good performance of toilets using only 6 liters of water. Tanks, bowls and the trim (flush mechanisms) have all been redesigned since the 6-liter standard was implemented in the US in 1995.

The toilet bowls have been re-engineered to work with the reduced water volume. Toilets rely partially on the siphonic force of water passing through the trap-way to pull all of the waste out of the bowl. Flush water reduction requires a narrower trap-way to achieve the siphonic action when using only 6 liters of water. Many manufacturers now glaze the trap-way to reduce friction as solid waste passes through the trap-way to the sewer line.

In general, toilet performance is enhanced by moving the water from the tank into the bowl as swiftly as possible. Many of the best performing gravity tank toilets use an early closure technology in the tank to gain the hydraulic pressure (head pressure) needed to transfer the water from the tank to the bowl in a very short time. Head pressure is determined by a combination of volume and height of water. The tank will hold 10 liters of water, but the trim will close the flush valve (in the tank) after only 6 liters of water has passed through to the bowl. The advantage is that the 6 liters of water passes into the bowl with greater velocity because the extra head pressure provided by 10 liters of water in the tank, even though only 6 liters of water is flushed through to the bowl.

There is a concern of persistent water savings from early-closure toilets. The flush valve in the tank requires a special feature to close the valve before all of the water has evacuated the tank. It is possible to either purposely, or inadvertently tamper with the valve, which causes the toilet to use all

of the water in the tank, beyond the 6 liters as intended. Most often, this problem occurs when the flush valve fails and is replaced with the wrong valve. Unfortunately, toilets not using the early closure design do not receive high scores in customer satisfaction surveys. When purchasing the toilets, it would be wise to require the highest quality flush valves be included, so that the valves do not require replacement for at least 5 years.

Most of the US gravity tank toilets can replace similar toilets in Jordan. There are two issues regarding installations. Both problems can be solved, but may require additional parts and labor.

All US toilets have mounting holes on the base of the bowl, beside the trap-way outlet. It is intended that the mounting bolts attach to the sewer flange, rise through the holes in the base of bowl, and are secured by fasteners. If the sewer flanges in Jordan cannot accommodate this, new bolts will have to be set into the floor beside the sewer line. This may add an extra hour of labor for each installation.

The water supply lines and the angle stops (shut-off valve) may have to be replaced, and may need adapters. It is not unusual to find that more than one out of 20 angle stops fail when toilets are replaced.

3.2.2.2 Pressure Assisted Tank Toilets

Pressure assisted toilets incorporate a sealed chamber residing inside of the tank. As water fills this sealed chamber, the trapped air in the chamber is compressed. When the toilet flush is activated, the water is emitted from the tank into the bowl under the pressure supplied by the compressed air. This design often provides superior flushing performance when compared to the typical gravity tank toilet.

There are several reasons why this design is not appropriate for Jordan. The extra flushing performance is seldom needed for most installation sites. The toilets are more than twice the cost of typical gravity tank toilets. The complicated design has been proven problematic in the US, and not likely to be more reliable considering the high level of sediment in Jordan's water. The system relies on consistent water pressure above 1 bar (15 psi), while Jordan has inconsistent water pressure. If the system fails, replacement parts may be difficult to obtain in Jordan.

3.2.2.3 Flush-o-meter type toilets

Flush-o-meter type toilets do not store water in a tank for flushing. The flush action is achieved by using a large diameter pipe to supply the water to the bowl in only a few seconds. The design eliminates the need for a tank attached to the bowl, but can only be installed at sites where water pressure is consistently above 1 bar, and large water supply pipes are present, such as hospitals or other large commercial/institutional buildings.

There have been attempts in the US to simply replace Flush-o-meter valves from 14 liters/flush to 6 liters/flush without replacing the bowl. This has resulted in very unsatisfactory performance. Just as in gravity tank toilets, the bowls had to be re-engineered to properly flush using only 6 liters. Replacements in Jordan will require that both the bowls and the valves be replaced. Flush-o-meter

type toilets should only be installed in bathrooms where similar toilets already exist.

Because of the quality of the water and the inconsistent water pressure, it would be wise to use piston type Flush-o-meter valves in Jordan. The diaphragm type valves are easily clogged by sediment, and open up and remain open every time the water pressure is lost. The piston design is much less affected by sediment in the water. It would be wise to install screens to filter out sediment for either valve. The screens need to be cleaned on a regular basis, depending on water quality.

3.3 Toilet Retrofit Devices

Toilet retrofit devices are considered as part of a less expensive (and less effective) alternate strategy to toilet replacement. Before the availability of 6-liter toilets in the US, these devices were a large part of the US strategy to conserve water. The devices were effective and easily adapted to most US toilets using 14 to 20 liters per flush. Most devices saved approximately 1 liter per flush (6%) while not significantly affecting toilet performance. Before 1995, most toilets in the US used an excessive amount of water; thus the 6% water use reduction had little effect on flushing performance.

3.3.1 Existing conditions

This strategy may not be as applicable in Jordan because of the typical toilet found in Jordan. If the typical toilet in Jordan uses 6 to 12 liters per flush, a savings of 1 liter per flush represents an average of 11% reduction in water use (nearly twice the US average). Many of the toilets in Jordan are already flushing unsatisfactorily because the bowls (and trap-ways inside the bowls) have not been re-engineered for the reduced water volume. Reducing the water volume an additional 11% will likely cause additional problems with the toilets properly flushing the solid waste. Reducing flush volume in existing toilets may not be a practical strategy for Jordan.

3.3.2 Water Saving Devices for Existing Toilets

It is often erroneously argued that water displacement devices for gravity tank toilets offer no advantage over lowering water volume in tanks by bending down the float arm of the refill valve. (Refill valves are referred to as "ballcock assemblies" in the US.) Water savings devices are considered a better alternative than bending down the float arm for several reasons:

1. Bending the float arm can damage the refill valve.
2. A bent float arm is likely to twist; causing the float to jam the refill valve open.
3. Reducing the water level reduces both water volume and height, thus reducing head pressure.
4. Displacement devices only reduce volume of water, not the height.

3.3.2.1 Toilet Dams

A popular displacement device in the US during the 1980s, toilet dams are semi-flexible metal plates with rubber edges, approximately 20 cm by 10 cm. The dams are placed inside the tank, held in place by friction, to withhold some water from exiting the tank when the toilet is flushed. The strategy has been mostly abandoned in the US because the dams have difficulty retaining the seal for more than a year. Savings was estimated at one or two liters per flush, but never proven by scientific research.

3.3.2.2 Displacement Bags

This device is basically a plastic bag fill with water and placed inside the tank. The water in the bag displaces water in the tank, thus reducing the water used in flushing. There is a wide difference in

the cost and the quality of the bags used. Although simple bags can be purchased for only pennies (fils), it is generally wiser to spend a Dinar for heavy gauge plastic bags designed for this purpose. Displacement bags are considered more reliable than dams and less costly to distribute. The bags are estimated to save one to two liters per flush, depending on the size of the bag, and the quantity of bags placed in the tank.

Displacement bags could be used in the flush tanks of some turkish toilets to conserve water. This might be the only retrofit applicable for these type of toilets.

3.3.2.3 Leak Detection Refill Valves

Gravity tank toilets often have slow leaks at the flush valve. As water slowly seeps unnoticed from the tank into the bowl, the refill valve (ballcock assembly) keeps supplying water into the tank to maintain the tank water level determined by the float arm. Although this leak is so small that it often goes unnoticed, the leak can easily waste more than 1,500 liters of water per month.

Fluidmaster Inc. manufactures a refill valve (Water Sentry) that will not refill a toilet tank unless activated by flushing the toilet. If a small leak in the flush valve causes the tank to drain tank water into the bowl, the refill valve remains closed until the flush handle is pushed. The consumer will know that a leak exists when the toilet does not flush any water. Once the flush handle is pushed, the refill valve will open to fill the tank with water and allow the toilet to be flushed. The Water Sentry serves two purposes: it only allows one tank of water to be wasted at a time if the flush valve leaks; and it immediately notifies the user that a flush valve leak exists. The Water Sentry refill valve, as part of the ballcock assembly, mounts from the bottom of the tank, while many toilets in Jordan mount the refill valve at the side of the tank, near the top; thus there is limited application in Jordan for this device.

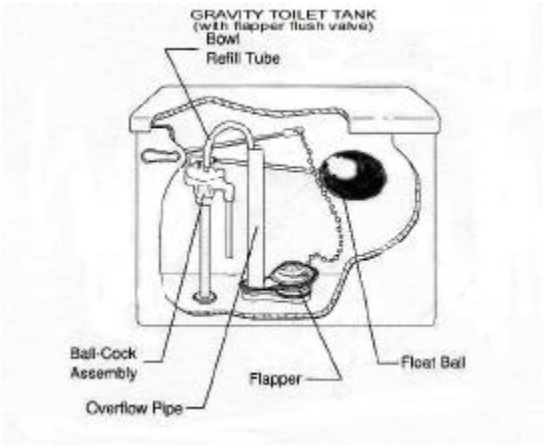
3.3.2.4 Flush Valve Replacement for Gravity Tank Toilets

Studies in the US indicate that almost 30% of toilets have a leaking flush valve. This is often caused by inferior materials used in making of the rubber valve and seat. Most toilets in the US use a flapper valve, and a few use a plunger type apparatus as a flush valve (Figure 3.1). Flapper valves are easily replaced in only a few minutes, while plunger valves require some disassembling of the plunger to replace the rubber gaskets.

Jordan appears to have a wide variety of flush valves. The most common apparatus is a plunger device. The main supplier of flush valves for Jordan Ceramics Co. uses a flush valve of very poor quality. The rubber gasket has a very rough surface, the gasket seats on top of un-milled plastic, and the valve guide is too short to ensure a consistent seating surface for the gasket. Most toilets using this valve probably leak upon or soon after installation. Replacing the existing rubber gasket with a high quality gasket would be advisable. The gasket should seal against a rubber seat, not hard plastic. At the very least, the plastic seat should be milled to provide a smooth seating surface for the gasket.

A third type of flush valve exists, but is seldom used in the US. The siphon flush valve, often used in England, uses siphonic action to transfer the water from the tank to the bowl. The design of the valve ensures that water cannot leak from the tank to the bowl. The siphon flush valve is large,

a.



b.

Figure 3.1 Flush valves for gravity toilet tanks: a. plunger flush valve, and b. flapper flush valve.

thus cannot fit inside small or odd sized tanks (as most tanks manufactured by Jordan Ceramics Co.). Replacing siphon flush valves require the tank be disassembled from the bowl for installation.

The replacement of the leaking flush valves in Jordan is very complicated because of the large variety of types of flush valves (due to many manufacturers, models and counties of origin for toilets found in Jordan). The best strategy might be to simply distribute leak detection (food dye) tablets so the consumers will be informed of the severity of the problem, and hopefully make the repairs necessary. This strategy should include information that suggests the probable cause of toilet leaks, the recommended repairs, and the estimated amount of water wasted by leaking flush valves.

3.3.2.5 Water Wardens for Flush-o-meter Type Valves

The diaphragm Flush-o-meter type valves can be retrofitted with a small disk named a "Water Warden". The disk is inserted in the flush valve to reduce the volume of water used in the flush cycle. The water reduction is typically 2 to 4 liters per flush at a cost of 5 Dinar per disk.

3.4 Showerheads

3.4.1 Existing Conditions

Showerheads in Jordan appear to use the same fittings as in US. The sediment content in Jordanian water clogs the small spray nozzles of low-flow showerheads very quickly. It was observed that many showers had the heads removed due to clogging. Only the shower arm (pipe extruding from the wall on which the showerhead attaches) existed at some institutional locations in Jordan. Hotels seem to favor the use of hand-held showerheads over fixed mount heads for the guest rooms.

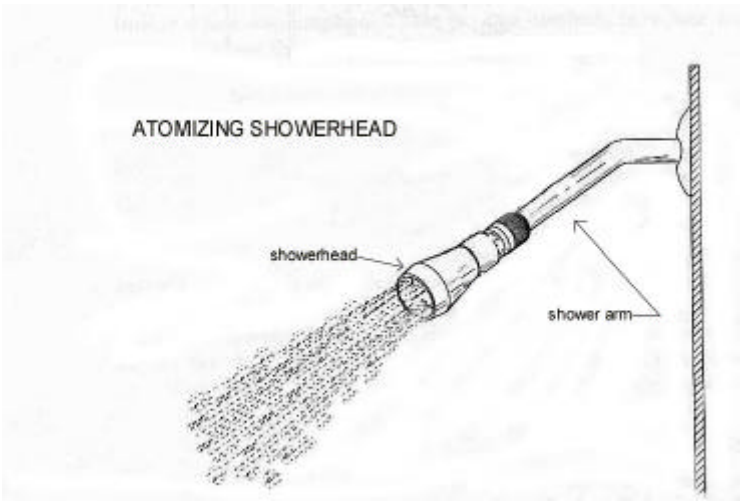
Sediment and scaling on showerheads can be easily removed by soaking the showerhead in vinegar for about a day. Any retrofit program should include instructions on how to properly maintain and clean the showerheads.

Most showerheads in the US are designed to use approximately 9 liters per minute at 80 psi (5.5 bar), and are required to have the flow rate stamped on the product. (There does not appear to be similar requirements in Jordan.) The water pressure in the US is fairly constant; thus a single standard flow rate is adequate. The highly variable water pressure in Jordan may require the selection of different showerhead models with several flow rates to accommodate the various water pressures at a single location.

There are three major types of water flows from different showerheads (Figure 3.2). Stream spray types use many small orifices in the head to emit water in many small streams. Atomizing heads are designed to create turbulence in the water as it passes through the head, resulting in the water broken into small droplets as it is emitted from the head at high velocity. Aerating models create some water turbulence and add air into the water as it passes through the head before being emitted as droplets at high velocity.

Atomizing and aerating type showerheads create small water droplets that are very quickly cooled as the droplets pass through the air before reaching the bather, thus these type of showerheads are no longer popular in the US. When reducing water volume to 9 liters per minute, the stream type showerheads receive the highest level of consumer satisfaction. The common low water pressure in Jordan dictates only stream type showerheads should be included in this project.

a.



b.

Figure 3.2 Types of water flows from showerheads: a. stream spray and b. atomizing showerhead.

3.4.2 Potential Showerhead Replacements

Showerheads made in and for the US have a maximum flow rate of 2.5 gallons per minute (9 liters per minute) at 80 psi (5.5 bar). These showerheads will typically emit only 4 to 6 liters per minute at 2 bar of water pressure. Although showerheads rated at less than 9 liter per minute are available, these heads would probably produce a very unsatisfactory shower in low water pressure locations commonly found in Jordan. This project should only use stream spray type showerheads with a flow rating of at least 8 liters per minute (at 5.5 bar).

3.4.3 Shower Shut-off Valves

Shutoff valves (Figure 3.3) are sometimes incorporated in the showerhead, or can be installed as a separate device between the shower arm and the showerhead. The valves are used to turn off the water to the showerhead while the bather is applying soap or shampoo (when a water spray is neither needed nor desired). The valve is convenient because it allows the bather to maintain the desired mix of hot and cold water while applying soap. After the bather has adjusted the water to the desired temperature, the bather simply turns the switch located near the showerhead to stop or resume the flow of water emitted by the showerhead.

It is estimated that half of the typical 10-minute shower involves the application of soap and shampoo, thus half of the water used for a shower can be saved by the use of a shut-off valve. It is not known how often the average bather uses such valves when installed.

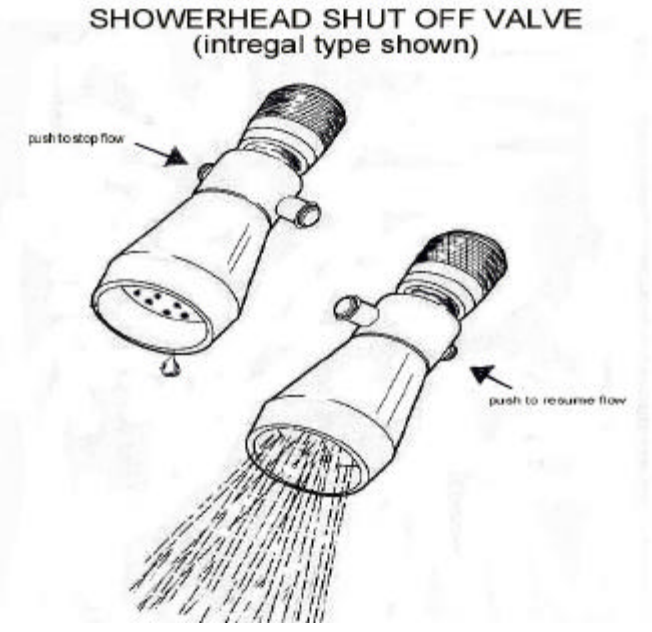


Figure 3.3 Showerhead shut off valve.

3.4.4 Maintenance

As discussed earlier, water-conserving showerheads are prone to clogging from sediment and scale, especially in hard water conditions typical of Jordan. Any strategy of showerhead replacements must include a strong emphasis on proper maintenance and cleaning of showerheads.

3.5 Aerators

Aerators are attached to the threaded end of the faucet spout (Figure 3.4). The function of an aerator is to mix air into the water as it passes through the faucet before it is emitted from the spout. The purpose of aerators is two fold. The air in the water provides a softer flow and reduced water force, which then reduces the splash of water when the water flow hits the bottom of the basin. The air also displaces water and thus reduces water usage (from approximately 12 liters/minute to approximately 6 liters/minute) whenever the faucet is used for rinsing. (It is generally believed that rinsing hands requires only 4 liters/minute of water.)

Aerators only achieve water conservation when the faucet is used for rinsing (usually when washing hands or rinsing dishes). It serves no purpose to install aerators if the primary use of the faucet is for filling wash basins, buckets, pots, pans, etc.; for an aerator will only require the consumer to spend more time to perform the task and not reduce water usage.

Conservation recommendations in the US are to provide 4 liters/minute for faucets used for washing and rinsing hands. For faucets that serve multiple functions, such as kitchen faucets, 8 liter/minute aerators are recommended.

The aeration devices in the aerators are of two designs. The most common aerators use small plastic disks that contain many tiny holes (approximately 0.5 millimeters) to reduce water flow and increase water velocity, which creates the venturi action to draw and mix air into the water. Unfortunately, the small holes are easily clogged by sediment in the water and require regular maintenance. The other type of aerator uses a brass disk with one small hole (approximately 7 millimeters) to achieve the same aeration effect, yet less prone to sediment

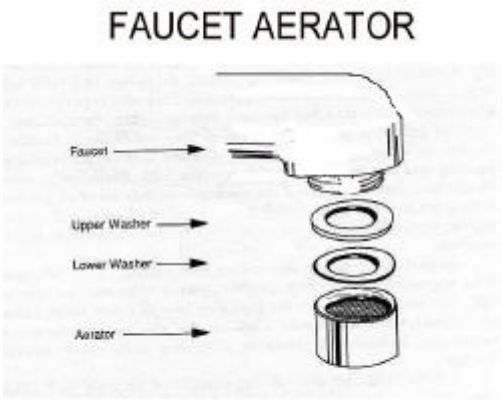


Figure 3.4 Faucet Aerator.

clogs. Unfortunately, the second type of aerator mentioned, does not work well at water pressures less than 5 bar with flow rates below 6 liters/minute.

3.5.1 Existing Conditions

Faucets and taps appear in bathrooms, kitchens, etc. The stalls for turkish toilets usually include a tap (with pitcher) to wash down waste. Most public-use faucets are not self-closing and do not have a threaded end to attach an aerator. Most faucets that did have a threaded end, either did not have any aerator attached, or were found with only a screen in the aerator. The hard water conditions probably lead to many clogged aerators; thus the maintenance staff simply removes the aeration disk to avoid the frequent clogs and cleaning.

Faucets are often attached to a 1/2" threaded pipe in the wall. In many public buildings, the faucet is attached to a pipe above the wash basin, unlike in the US where the faucet assembly is attached to the wash basin. Fortunately, faucets attached at the wall are very easy to replace.

Of the faucets (with threaded spouts) found in Jordan; there are many more thread sizes than typically found in the US. Faucets are imported from Europe, Asia and the US. Most faucets manufactured in Jordan include spout threads of 19mm M and 22mm M.

3.5.2 Potential Retrofits and Replacements for Faucets

It is recommended that 4 liters/minute aerators be installed at the wash basins of all bathrooms. Aerators rated at 8 liters/ minute should be installed on faucets used in kitchens. The variable water pressure found in multi-story buildings may require different flow rates for aerators depending on the available water pressure, i.e. location of the faucet. Since it is difficult to determine thread size, any retrofit project should stock all of the variable thread size aerators and be prepared to determine the needs of the building, while on site, by trying the various sized aerators for fit.

Wash basins and turkish toilet stalls of public restrooms should have faucets replaced with self-closing faucets. This prevents a user from leaving the restroom with the water valve open. The spring actuated shut-off valves are preferable to electronic types because the spring type offers simplicity in repair and maintenance. Replacement faucets for wash basins should be of the type that includes threaded spouts with aerators attached. There is no advantage to attaching aerators to faucets installed in turkish toilet stalls.

Any strategy that includes aerators must also include instructions on proper maintenance and cleaning of aerators. Periodic removal and rinsing is needed to remove sediment buildup. Scaling can be removed by soaking the aerators in vinegar for an hour, then brushing the aerator until clean. All aerators should include a domed screen (Figure 3.5) to prevent sediment from clogging the small holes in the aeration disk.

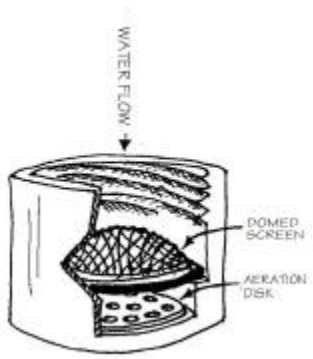


Figure 3.5 Domed Screen Aerator

3.6 Urinals

3.6.1 Existing Conditions

Urinals are occasionally found in public restrooms. Some urinals use Flush-o-meter type valves for flushing. More often, the urinals are flushed by a manually controlled valve, or flushed automatically by a master valve that is actuated by a timer.

The timer-actuated flushes are generally considered to be wasteful. The timer does not regulate flushes based on urinal usage. Manual valves are sometimes left open after the user has exited the restroom.

3.6.2 Potential Urinal Retrofits and Replacements

It is generally recommended that only 4 liters of water be used to flush a urinal. Unlike Flush-o-meter type toilets, most Flush-o-meter urinals can be easily retrofitted with a 4-liter/flush valve, without replacing the ceramic fixture. Due to the high amount of sediment in Jordan water, it would be wise to use piston type Flush-o-meter valves rather than diaphragm type valves.

The manual flush valves should be replaced with automatic shut-off valves whenever possible. This would assure the water is shut-off except when a user is holding the valve open. As with faucets, spring actuated shut-off valves for urinals are much easier to repair and maintain than electronic versions.

Timer actuated urinal flush valves should be replaced, unless the site has consistent urinal use 24 hours per day. Water could be conserved by replacing all such urinals with manual flush valves. This retrofit may require re-piping at some sites, where water supply pipes are not exposed to install a manual flush valve.

The best strategy might be to replace all urinals with "Waterless Urinals" (Figure 3.6). Waterless Urinals do not use any water to eliminate the waste. The urinals are constructed of a special plastic that repels liquids. The liquid waste is sent through a unique trap-way that allows waste to travel to the sewer line. The urinals are easily cleaned by spraying a disinfectant fluid on the urinal surface once per day. As with all fixtures, it is imperative that the building staff are given proper maintenance instructions.

Figure (3.6) Waterless Urinal

3.7 Clothes Washers

The innovation in water efficient clothes washer is mostly found in small residential machines. Due to cost savings in manufacturing, most residential machines are designed for a vertical-axis wash drum (usually top loading). This type of design, while cheaper to manufacture, uses 35% more water than a horizontal-axis design (usually front loading).

Virtually all commercial and institutional sites in US (like Jordan) use large horizontal axis clothes washers. Replacement strategies in the US focus on market segments where vertical-axis machines are prevalent, such as residences and self-serve laundromats.

Where allowed by health codes, many US institutions include a water re-use system to re-use the

water from the final rinse cycle as source water for the wash cycle in the following load of laundry. The most common laundry re-use systems are custom packaged units, which include all of the necessary valves, pumps, electronic controls, filters, water heaters, and disinfectant applicators. Depending on the laundry system, 20 to 45% of the water is recycled on each load, thus conserved.

3.7.1 Existing Conditions

Commercial and institutional sites in Jordan mostly use large horizontal-axis, or industrial size machines. Very few sites have a water re-use system in place for the laundry facilities.

It is unknown at this time what health codes and standards exist in Jordan regarding water re-use in laundry facilities. Hospitals might be restricted from such systems due to concerns of re-contamination of pathogens.

Local customs and religious beliefs may also prevent acceptance of re-using water in laundry facilities.

3.7.2 Potential Retrofits

Most market segments (commercial, government, institutional etc.) surveyed in this project have little potential for replacing vertical-axis machines. Hotels and institutions have a great potential for water re-use systems to conserve water.

Health codes of Jordan should be reviewed to verify the potential of water re-use systems. A search for companies that manufacture, install and maintain laundry re-use systems should be conducted. These companies should be invited to Jordan to conduct feasibility studies on the sites with the greatest amount of laundry use, such as hospitals, hotels, etc.

3.8 Other

3.8.1 Leak Detection Tablets

Leak detection tablets are effervescent food coloring tablets that are placed in the tanks of gravity toilets to detect leaking flush valves. The tablets will color the water in the tank a dark blue. If the flush valve leaks, the blue water will appear in the toilet bowl within a few minutes.

To assist consumers in locating leaking toilets, a public awareness campaign should be conducted. The strategy should include:

1. Distributing dye tablets to assist in detecting leaking flush valves.
2. Estimations on the annual water wasted by toilet leaks.
3. List of probable causes of toilet leaks.
4. Recommend measures to repair and prevent toilets leaks.

3.8.2 Leak Gauges

Leak gauges are small measuring cups, used to collect water from leaking faucets for a preset amount of time (usually 5 seconds). The cup has graduated marks on its side, which provides an estimate of the annual amount of water wasted by the leak. The purpose is to inform the consumer of the large amount of water a seemingly small leak will waste over a year. Leak gauges can also estimate water loss from dripping faucets by calculating annual loss based on number of drips per ten seconds.

Public awareness campaigns can include leak gauges as part of the water conservation strategy. Leak gauges should be accompanied by information regarding probable causes of leaks and the appropriate remedies. Leak gauges can include brief customer messages printed on the gauge.

3.8.3 Shower timers

Shower timers are simple devices using sand sealed in an "hourglass" attached to a rotating base with a suction cup. The non-breakable plastic device attaches to the shower wall by the use of a suction cup. The device is design so that the sand in the "hourglass" will travel through the reservoir in 5 minutes. The purpose is to inform the bather when the preferred time (5 minutes) for a shower has expired.

The bather uses the device by rotating the base when starting the shower. This action causes the sand to start flowing. The bather then attempts to complete the shower in less than 5 minutes, as indicated by the timer.

Chapter 4
COST BENEFIT ANALYSIS

4.1 Background

The WEPIA study team was assembled in late March 2000 and began its survey in late April. With the results of the survey and a narrowing of the scope of work to public buildings, the team developed a cost benefit analysis based on the few WSDs deemed appropriate to large consumers of water in Jordan during this time. There is deliberate emphasis on toilets in these calculations as it is evident that there is far greater water and cost savings to be obtained from this one fixture than from the others. In all countries where water conservation standards have been established, low flush or no-flush toilets and there appropriate bowls are considered a water saving device.

4.2 Boundaries and Constraints

The WEPIA study team focused on over five hundred large consumers (500 M3/cycle) in the public and private sectors and 224 of those in the public sector were appropriate sites for some type of retrofitting with water saving devices. The team recommended only those water saving devices based on their appropriateness, cost, availability and simplicity of installation.

4.3 Methodology

Several assumptions were made before carrying out the analysis:

Technical assumptions

1. Building maintenance staff will provide proper maintenance to assure the WSDs remain in proper working order.
2. The estimated use of western toilets versus Turkish toilets is derived directly from fixture counts of the two types.
3. The frequency of fixture use is similar to the US, except:

a. Shower use is adjusted to local customs, based on type of facility and its use by occupants.
b. Faucet use is adjusted to local customs based on type of facility and its use by occupants.
c. Mixers and taps have threads for aerators, thus do not require replacement.

4.3.1 Toilet and Urinal Use Assumptions

Water consumption is based on a complicated relationship between frequency of use and water flow and flush rates. The frequency of the use of fixtures were derived from US studies and adapted to Jordanian customs where appropriate. There are no known studies, which directly explain the use of plumbing fixtures in commercial buildings in Jordan. It is well documented from US residential studies that a person will flush a toilet an average of seven times per day when they are at home all day. US Studies have also shown that a typical adult will flush the toilet an average of four times a workday at home, when they have a full-time job. It is therefore assumed that three flushes per day per person occur at the place of work.

Most people surveyed will estimate their frequency of bathroom use to be much lower, but US studies using several different monitoring techniques have consistently proven the frequency to be between six and eight times per day per person. What is unknown is whether the frequency changes on workdays versus weekdays. For the purpose of this study, we are assuming the frequency does not change, thus we assumed three flushes per day per person per eight-hour workday at the commercial sites.

4.3.1.1 Hotels, Hospitals and Restaurants

There are several types of facilities that also incur significant water use from guests and patrons, most notably hotels and hospitals. At hotels we assumed that each guest performed five of the seven flushes per day within the hotel. We did not account for any patrons using facilities that were not registered guests, such as restaurant guests, or meeting and banquet attendees. In-patients (overnight patients) at hospitals were assumed to average five flushes per day (we lowered the frequency from 7 to 5 to account for patients that were not ambulatory). Outpatient frequency was estimated at two flushes per day. We did not account for any flushes performed by the many visitors that spend time with patients in the hospitals. Restaurant patrons were assumed to use bathroom facilities less than approximately one-half times per visit.

N.B. Though not included in the estimates above, WEPIA conducted an in depth study of Al Bashir Hospital (see appendix) which showed a high use of sanitary facilities by the employees, not just patients and their visitors.

4.3.1.2 Behavioral Issues

We assumed that males would prefer to use the urinals when such fixtures were available. This comes from US studies verifying that males preferred using urinals over western toilets when both were available. The use of western type toilets versus Turkish toilets was based on the ratio of such fixtures at each facility.

4.3.2 Faucet Use Assumptions

The analysis assumed that washing of hands would occur with each restroom use. An estimated time of fifteen seconds per use was used in most instances. Additional time was added for religious ablution, where appropriate. Hotel guests were assessed thirty seconds per use to account for extensive morning uses such as brushing teeth, face washing and shaving. Similar to Toilet Assumptions, hospital visitors, and hotel visitors not registered as overnight guests were not assessed any faucet use.

4.3.3 Shower Use Assumptions

Shower duration was estimated at ten minutes per use for private showers (hotels rooms, faculty housing, etc.), and six to eight minutes per use for common shower facilities such as hotel employee showers, fitness centers, etc. The quantity of daily showers was estimated based on: reports from facility managers, quantity of potential users, and quantity of shower fixtures. Hotels estimates were based on one shower per day per registered guest. Given the underestimates of frequency of use, water savings could be as much as 15-20% higher than estimates provided here.

4.4 Financial Analysis

Financial assumptions

1. The WSDs project life span is 10 years.
2. Salvage values of WSDs equal zero at the end of year ten.
3. No extra maintenance cost is needed over the life of the project except in the case of waterless urinals
4. Program and management cost are not included.
5. The costs of WSD installation and training of installation teams are not included in the analysis.
6. All calculations are made assuming the year 2000 prices. For example, the price of water remains constant at (JD 1.5 / m^3) over the life of the project.

Purchase, shipping, and installations costs (without plumbing renovations) remain constant. Cost estimates are as follows:

a.	Toilets	$200
b.	Waterless Urinals	$596
c.	Self-closing taps (not mixers)	$ 35
d.	Aerators	$ 5
e.	Shower heads	$ 29

1. Installation and warehousing of WSDs will occur over a 10 month period.
2. Costs for plumbing renovations (such as replacing or moving water and wastewater pipes) are not included in our cost estimates.
3. All WSD installation sites will be supplied with spare replacement parts and extra WSDs.

4. Maintenance costs of WSDs are not included UNLESS these costs are greater than maintenance costs of existing fixtures.
5. Numbers and types of fixtures are projected from the demand side survey results summarized in Table 4.1.

4.4.1. Time value of money

Time value of money is a critical consideration in financial decisions. Compound interest calculations determine the future sum of money that will result from an investment. Discounting, or the calculations of present value, is inversely related to compounding. It is used to evaluate future cash flow associated with capital budgeting projects.

The following three criteria are widely used to evaluate proposed investments.

4.4.1.1 Payback period

The payback period is the length of time required to recover the initial capital investment.

Calculation
If the cash inflows are uniform:
Payback period = Initial investment divided by Annual cash inflows
If annual cash inflows are not even, the payback period must be determined by trial and error.

Payback reciprocal
Reciprocal of the payback time gives a quick, accurate estimate of the internal rate of return (IRR) on an investment when the project life is more than twice the payback period and the cash inflows are uniform every period.

Decision rule
Choose the project with the shorter payback period because there is greater liquidity and less risk.

4.4.1.2. Net present value method

The net present value (NPV) method is a discounted cash flow technique widely used for evaluating investment projects. Under the NPV method, the present value (PV) of all cash inflows from the project is compared to the initial investment (I).

Calculation:
The future net cash flows from the project are discounted to their present value at an appropriate discount rate (the project's cost of capital).

The initial cost of the project is then subtracted from the present value to determine the NPV.

Decision rule
If the net present value is positive (NPV > 0 or PV > I), the project should be accepted. If it is negative, the project should be rejected.

If two projects are mutually exclusive, the one with the higher NPV should be selected.

4.4.1.3. Internal rate of return (IRR)

Internal rate of return (IRR) is the time adjusted, real rate earned on a proposal.

Computation
IRR is that rate of interest that equates the initial investment (I) with the present value (PV) of future cash inflows. That is; IRR, I = PV, or NPV (net present value) = 0.

Decision rule
Accept the project if IRR exceeds the cost of capital; otherwise reject the proposal.
The IRR method ranks mutually exclusive investments differently from the NPV method if
1. The cost of one project is larger than the cost of the other, and
2. The timing of the project's cash flow differs over time.

4.5 Findings

4.5.1 Toilets

1. In most cases it is better to replace the entire toilet than to try to reengineer different parts.

2. Some installation sites (hospitals) may require elongated bowls and designs for the disabled however there are not enough special needs in "25% of public sites to merit purchase at this time. Also the flush in a round bowl is better than an elongated one.

3. The best prices are based on purchasing in large quantities (e.g. 500 units in a full shipping container.

4. Most sites will use 12-inch rough-in but a few will require 10-inch.

4.5.2 Waterless Urinals

1. Water saving is one hundred percent.
2. Training of maintenance staff is needed since this is a new technology in Jordan.
3. Were possible urinals could replace toilets.

4.5.3 Taps

1. Some taps should be replaced if they are leaking or lack threads.

4.5.4 Aerators

1. Because of high sediment in Jordanian water dome shaped aerators are preferred.
2. Because of pressure inconsistencies, pressure compensating aerators are preferable.

4.5.5. Shower heads

1. Sediment in water makes use of flow restrictors problematic
2. Atomizing shower heads have a low level of customer satisfaction

4.6 Recommendations

Very specific recommendations are found in Figures 4.1 to 4.9 that identify cost estimate factors (Table 4.2 to 4.5) of items recommend for purchase in the United States, Jordan or elsewhere. Recommendations for toilets, flapper valves and refill valves are specified by name and model. Waterless urinals are recommended and can only be purchased in the USA. Aerators, taps and shower heads (9.5 l/m) are also identified but may be purchased locally or elsewhere. Installation and warehouse costs are included, as well as tariffs, where known. Below are general recommendations based on WEPIA findings.

4.6.1. Toilets

In most cases it is preferable to replace the entire toilet with a round 6 liter per flush model. High quality flapper valves are a must. Refill valves with special leak detection features are the best.

4.6.2 Urinals

Waterless urinals are preferable if there is maintenance training available.

4.6.3 Taps

Self-closing and wall mount is preferred. Replace threadless and leaky taps with new ones.

4.6.4 Aerators

Dome screen and pressure compensating for 4-liter/ minute are recommended.

4.6.5 Shower heads

Spray head and pressure compensating with a brass coupling are preferred.

Table 4.1 Summary of the Demand Side Survey Results

Category	Public/Private	Site	Sinks		Toilets		Showers	
			No.	Avg.(L/min)	No.	Avg.(L/Flush)	No.	Avg.(L/m
Government	Public	Amman Public Library	21	10	10	6	0	0
		Free Zones Corporation/AQABA	25	N/A	20	N/A	0	0
		Port Corporation/AQABA	3150	N/A	1550	N/A	750	N/A
Amman Municipality		City Hall	180	9	122	N/A	2	N/A
		Public WCs	0	0	12	N/A	0	0
		Slaughter House	17	12.5	12	20	7	25
Ministries	Public	Ministry of Aoqaf	20	24	25	7	0	0
		Ministry of Communications	19	29	24	10	0	0
		Ministry of public works	106	18	87	13	0	0
		Ministry Water & Irrigation	31	60	68	4	0	0
		Ministry of Education	62	18	80	N/A	0	0
Schools	Public	Ain- Jaloot Comp. School	78	7	20	6	0	0
		Al-hassan Bin Al Haetham	57	20	27	6	0	0
		Aqaba Vocational Center	136	12	150		67	N/A
		Nuzha Vocational School	57	11	26	6	0	0
		Samir al-Refa'I Sec. Com. School	35	4	32	6	0	0
		Umm Tuffayl Girls School	43	7.5	12	5	0	0
		Omar Bin Al-kattab Voctioal	23	9	16	9	0	0
		Janna'a Essential School	26	6	18	6	0	0
	Private	Amman Bacalurate	N/A	10.5	14	7	0	0
		Dar Al-Arqum School	164	4	164	5	0	0
		Rosary Collage –Aqaba	0	14	0	12	0	0
		Ithad Shool for Boys	720	4	720	5	8	20
Universites	Public	JUST	1929	14	1033	10	141	38

Universites	Private	Al- Zaytonah Uni.of Jordan	66	3	130	9	3	60
Banks	Private	Housing Bank	41	6	44	12	0	0
	Private	Union Bank	34	3	30	15	0	0
Clubs	Private	Orthodox	60	8	48	10	48	20
Restaurants	Private	Kanari	5	9	5	6	0	0
Companies	Private	Arab Potash co.	40	25	26	11	0	0
		Jordan Phosphate	77	31	85	10	2	N/A
		Jordan Refinary	30	15	32	5	2	N/A
Factories	Private	Hikma	52	9	38	16	0	0
		Arab Alaminum Industry	25	11	25	7	25	9
		Jordan Diary Co.	35	12	10	6	0	0
		Jordan ice & Aerated Co.	11	20	5	6	6	20
Hospitals	Private	Arab Center for Heart	298	13	184	13	126	13
		Jordan Hospital	150	3	130	6	104	4
		Rosary Hospital	227	40	126	10	91	10
	Public	Basheer Hospital	860	25	350	5	400	N/A
		King Abdulla Hospital	1157	8	10	8	377	N/A
		King Hussain M.C	505	20	157	12	125	30
Hotels (5*)	Private	Intercontinental	969	20	720	6	480	12
		Holiday Inn	230	8	218	12	230	12
		Movenpick	360	6	330	8	260	12
(4*)		Ammon Hotel	137	N/A	72	N/A	62	N/A
		Amra Froum	329	17	321	6	350	12
		Aquba Gulf	202	10.5	225	14	202	8
		Dana Plaza	194	8	115	7	100	20
(3*)		Marmara Hotel	40	9	40	6	31	6
		Middle East Hotel	221	19	115	10	106	7
		Meramar Hotel	129	N/A	129	10	140	N/A
(2*)		Caravan Hotel	25	9.5	25	9	25	12
		Gandola Hotel & Suites	46	10	46	6	46	11
Colleges	Public	Prince Allia College	31	9	29	6	0	N/A
Mosques	Public	Al- Hussaini	30	10.5	0	0	0	0
		Irbid Biggest Mosque	33	3	22	6	0	0
		King Abdulla Mosque	21	8	47	11	0	0
Societies	Public	Orphans Care Societes	20	13	23	6	18	11

Table 4-2 Private Sector Survey Results

PRIVATE FACILITIES	100% of Potential					
CATEGORY	Western Toilet	Turkish Toilet	Urinals	Faucets	Showers	
Water Saved, 10 years - m3	2,576,853	-	2,484,420	1,425,472	1,132,798	
Cost of Retrofit US$	$ 2,701,623	$ -	$ 1,540,064	$ 542,094	$ 251,555	$
Cost per m3 saved	$ 1.05	$ -	$ 0.62	$ 0.38	$ 0.22	$
Value of Water Saved (1.50JD)	3,865,279	-	3,726,630	2,138,208	1,699,197	
Value of Water Saved US$	5,459,434	-	5,263,602	3,020,068	2,399,996	
Benefit/Cost	2.0	0.0	3.4	5.6	9.5	
Annual H2O m3	257,685	-	248,442	142,547	113,280	
Annual value - US conversion	$ 545,943	$ -	$ 526,360	$ 302,007	$ 240,000	$
Simple Payback in Years	4.95	-	2.93	1.79	1.05	

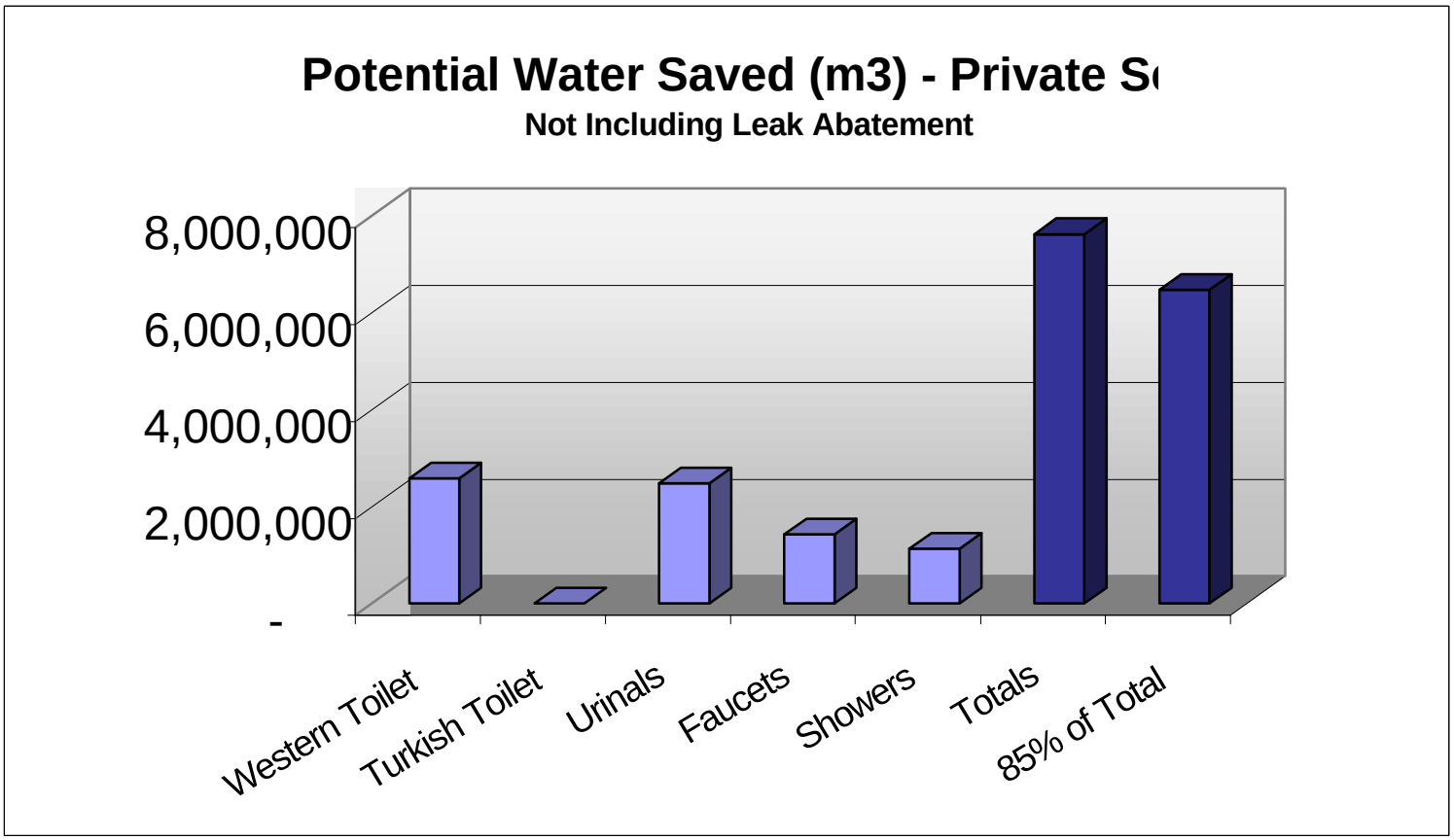


Figure 4.1 Potential Water Savings for the Private Sector.

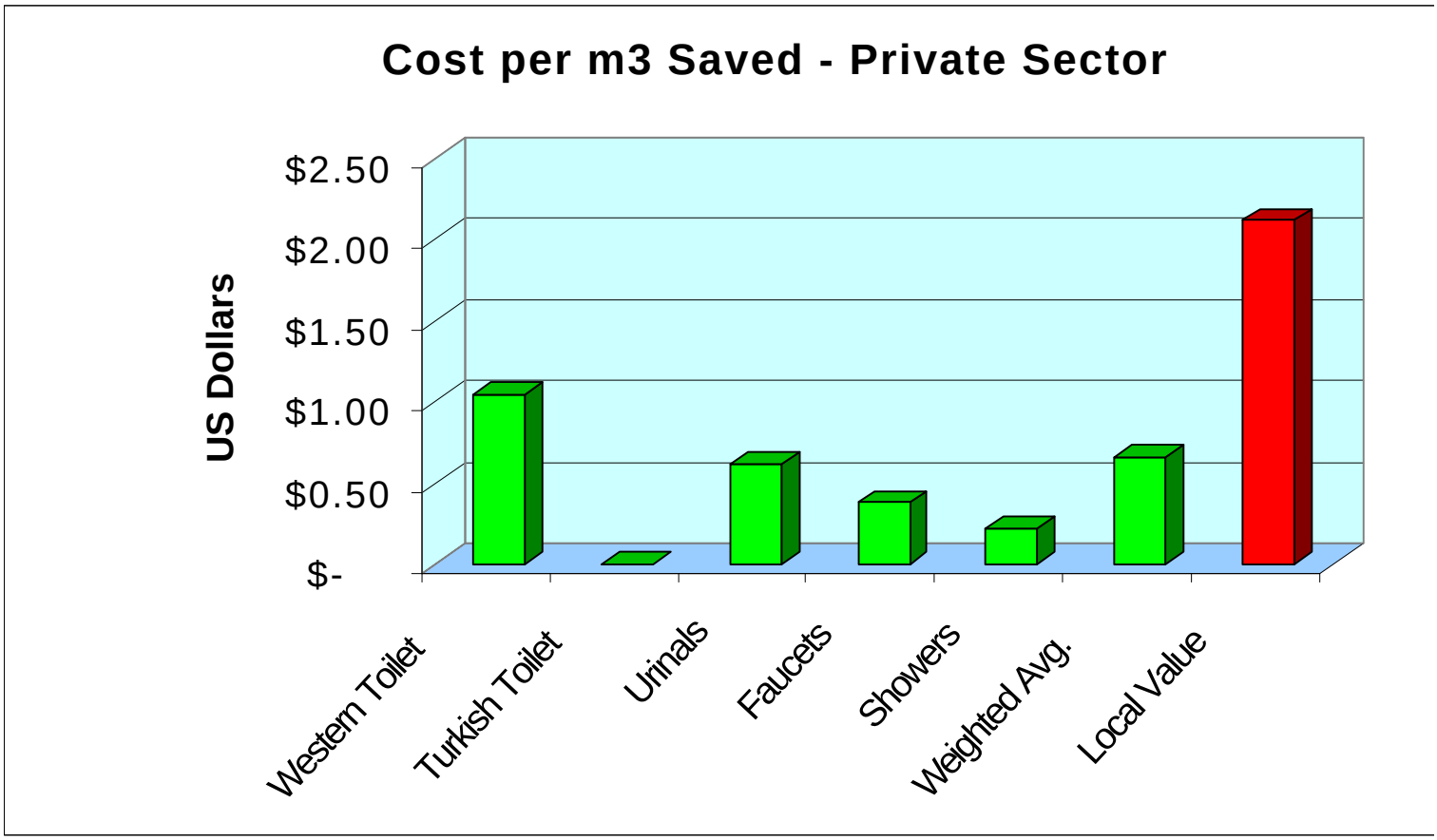


Figure 4.2 Anticipated Cost per Cubic Meters of Water Saved for the Private Sector.

Table 4-3 Assessment Results for Private Facilities.

PRIVATE FACILITIES		100% of Potential							
CATEGORY		Restaurants	Banks	Factories	Universities	Companies	Schools	Hotels	I
10 year Qty. of Water Saved		25,658	193,774	792,924	368,395	681,496	1,390,205	3,068,402	
Total Value of Water Saved - JD	1.5	38,487	290,661	1,189,387	552,593	1,022,244	2,085,307	4,602,603	
Total Value of Water Saved - US$		$ 54,360	$410,538	$1,679,925	$ 780,498	$1,443,848	$2,945,349	$6,500,852	$
Total Cost of Retrofits / US$		$ 9,775	$ 54,286	$ 474,610	$ 299,756	$ 237,760	$ 787,439	$2,196,737	
$Cost per Meter Cubed Saved		$ 0.38	$ 0.28	$ 0.60	$ 0.81	$ 0.35	$ 0.57	$ 0.72	
Cost/Benefit		5.6	7.6	3.5	2.6	6.1	3.7	3.0	
Rate of return		18%	13%	28%	38%	16%	27%	34%	
Annual H2O		2,566	19,377	79,292	36,840	68,150	139,020	306,840	
Annual value / US$		$ 5,436	$ 41,054	$ 167,992	$ 78,050	$ 144,385	$ 294,535	$ 650,085	
Simple Payback in Years		1.80	1.32	2.83	3.84	1.65	2.67	3.38	

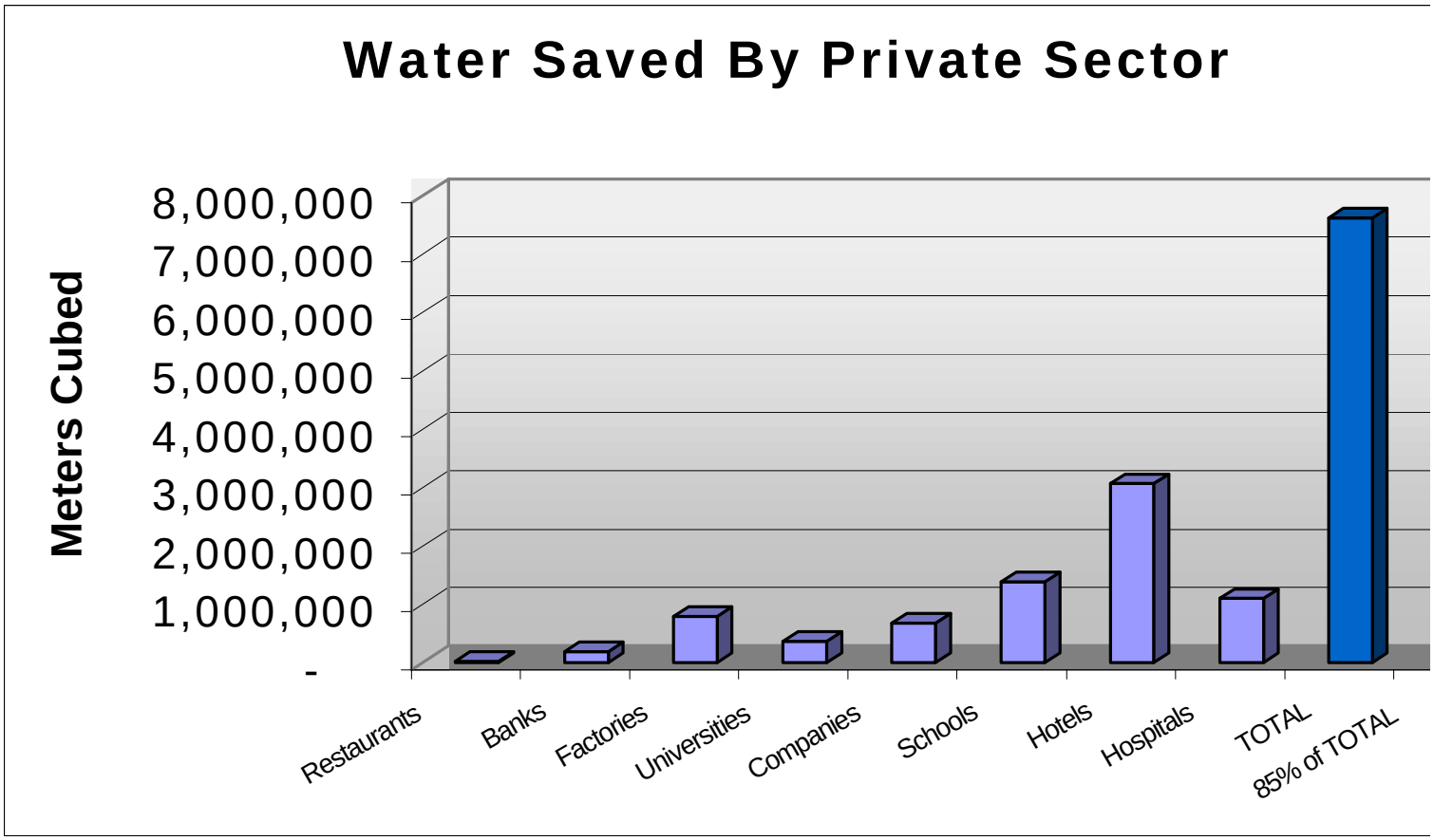


Figure 4.3 Estimates of Quantities of Water Saved by the Private Sector.

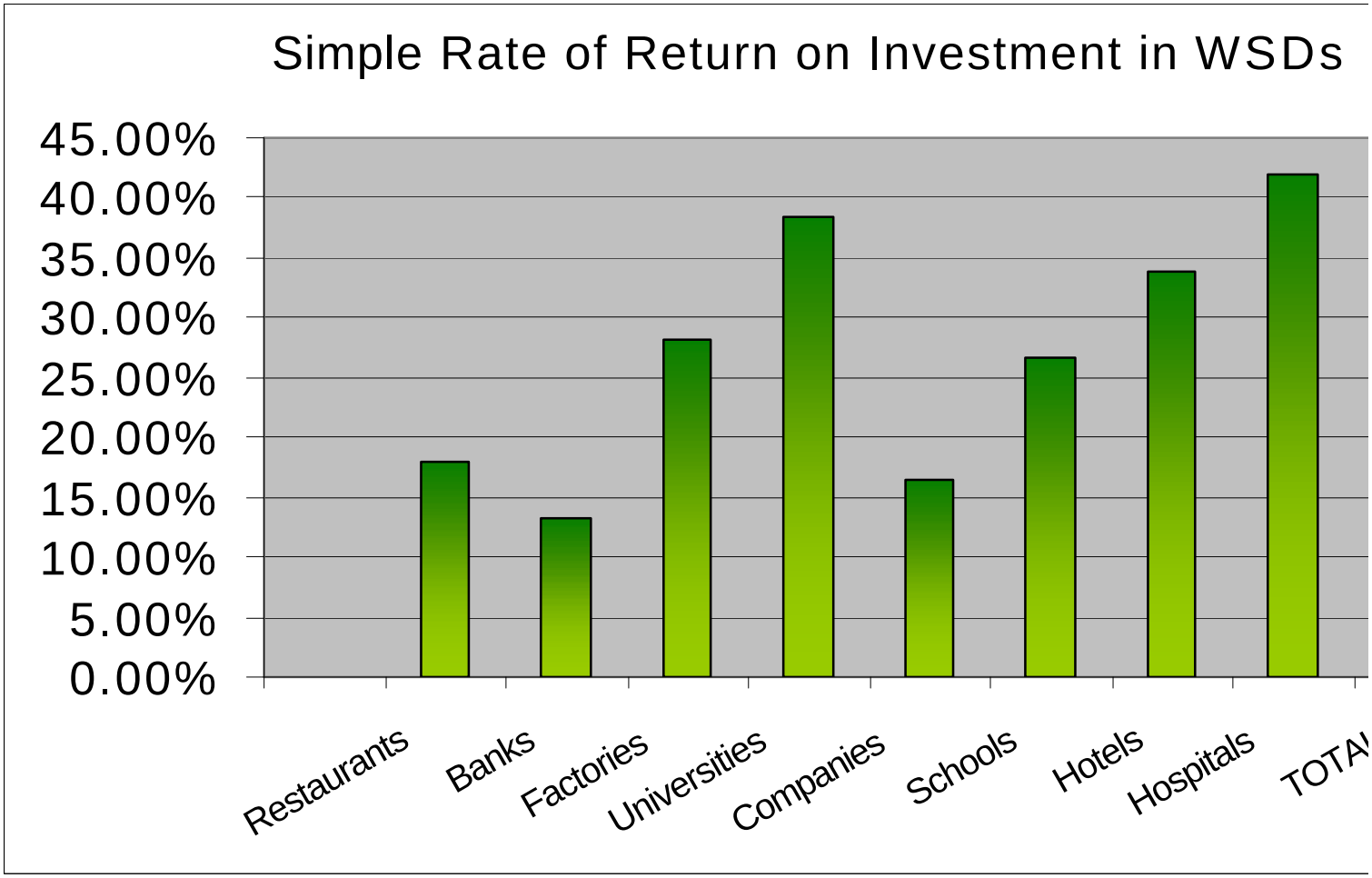


Figure 4.4 Financial Analysis Results for the Private Sector (Simple Rate of Return).

Table 4.4 Public Sector Survey Results

PUBLIC FACILITIES	100% of Potential					
CATEGORY	Western Toilet	Turkish Toilet	Urinals	Faucets	Showers	
Water Saved, 10 years - m3	2,144,613	0	1,934,350	2,491,729	1,008,996	
Cost of Retrofit US$	$ 1,592,550	$ -	$ 1,546,620	$ 850,700	$ 122,105	$
Cost per m3 saved	$ 0.74	$ -	$ 0.80	$ 0.34	$ 0.12	$
Value of Water Saved (1.50JD)	3,216,920	-	2,901,524	3,737,593	1,513,493	
Value of Water Saved US$	4,543,673	-	4,098,198	5,279,086	2,137,702	
Benefit/Cost	2.9	0.0	2.6	6.2	17.5	
Annual H2O m3	214,461	-	193,435	249,173	100,900	
Annual value - US conversion	$ 454,367	$ -	$ 409,820	$ 527,909	$ 213,770	$
Simple Payback in Years	3.50	-	3.77	1.61	0.57	

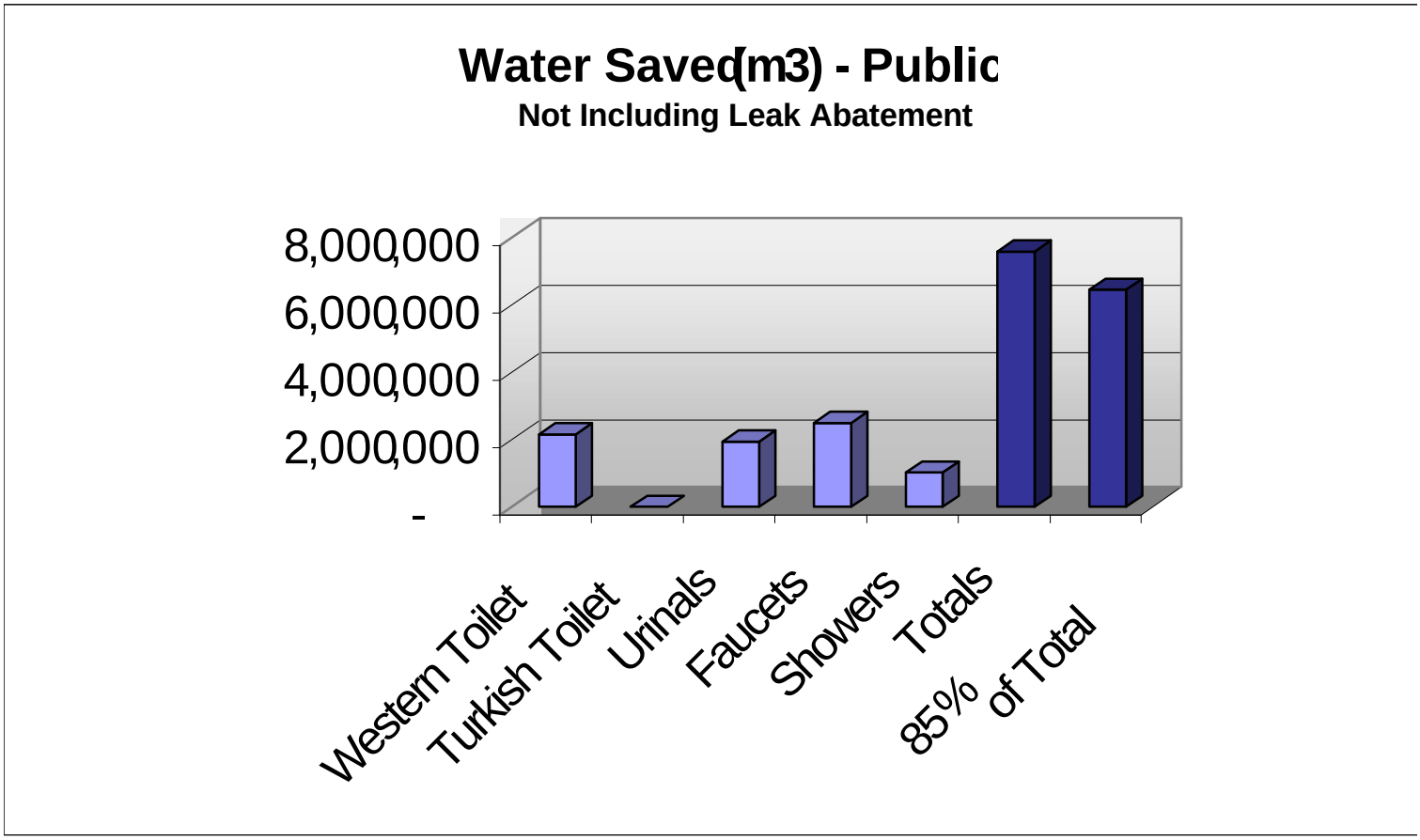


Figure 4.5 Potential Water Savings by the Public Sector.

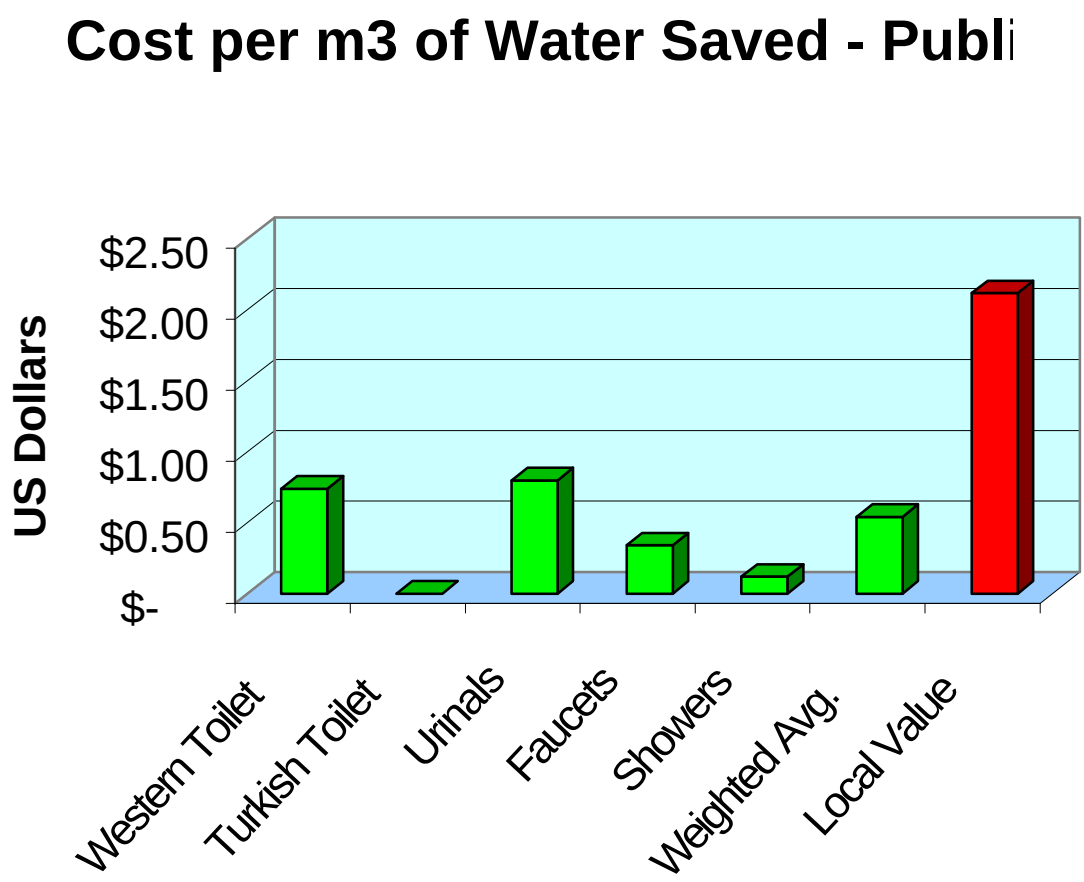


Figure 4.6 Anticipated Cost per Cubic Meters of Water Saved for the Public Sector.

Table 4.5 Results of Analysis of Water Savings by Public Sector.

PUBLIC FACILITIES	100% of Potential				
CATEGORY	GOVERNMENT	SCHOOLS	COLLEGES& UNIVERSITIES	MOSQUES	HOSPITALS
10 year Qty. of Water Saved	2,558,640	825,737	2,104,204	201,877	1,889,229
Total Value of Water Saved – JD	3,837,961	1,238,605	3,156,306	302,815	2,833,844
Total Value of Water Saved - US$	$ 5,420,848	$ 1,749,442	$ 4,458,059	$427,705	$ 4,002,604
Total Cost of Retrofits / US$	$ 1,496,032	$ 176,702	$ 1,654,260	$ 2,835	$ 782,146
$Cost per Meter Cubed Saved	$ 0.58	$ 0.21	$ 0.79	$ 0.01	$ 0.41
Benefit/Cost	3.6	9.9	2.7	150.9	5.1
Annual H2O	255,864	82,574	210,420	20,188	188,923
Annual value / US$	$ 542,085	$ 174,944	$ 445,806	$ 42,771	$ 400,260
Simple Payback in Years	2.76	1.01	3.71	0.07	1.95

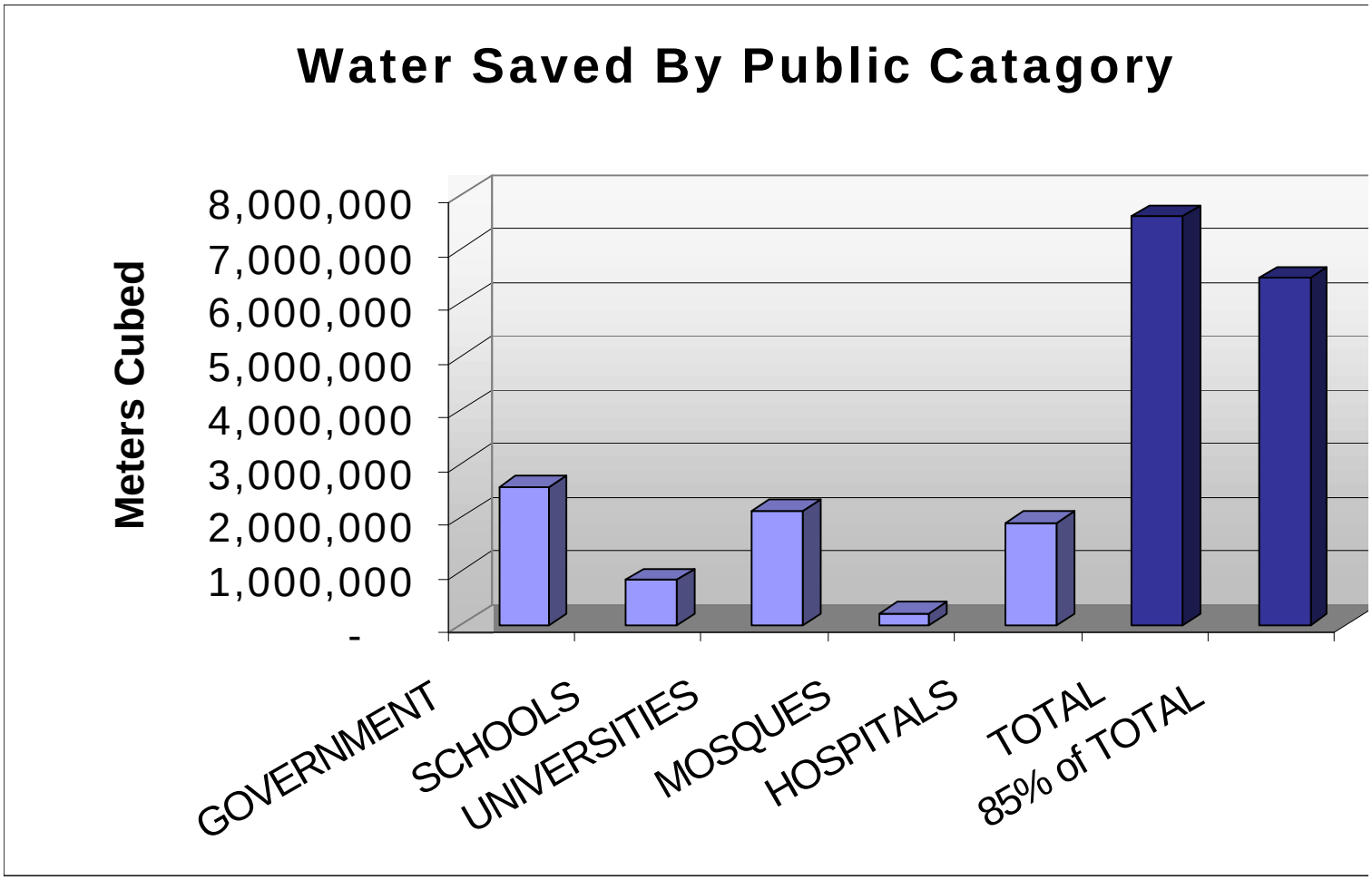


Figure 4.7 Estimates of Quantities of Water Saved by the Public Sector.

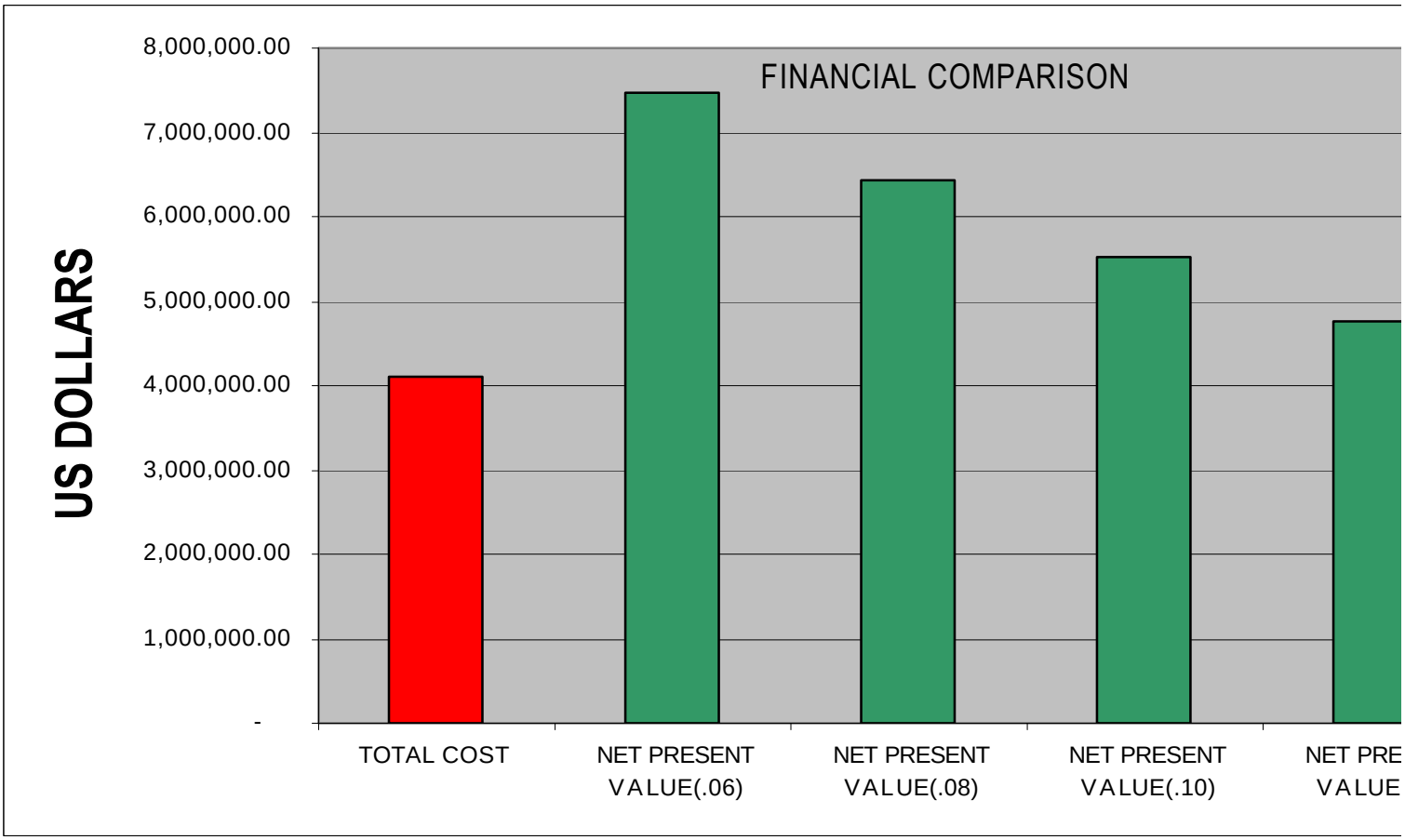


Figure 4.8 Financial Comparison for Investing in Retrofitting Public Buildings with WSDs.

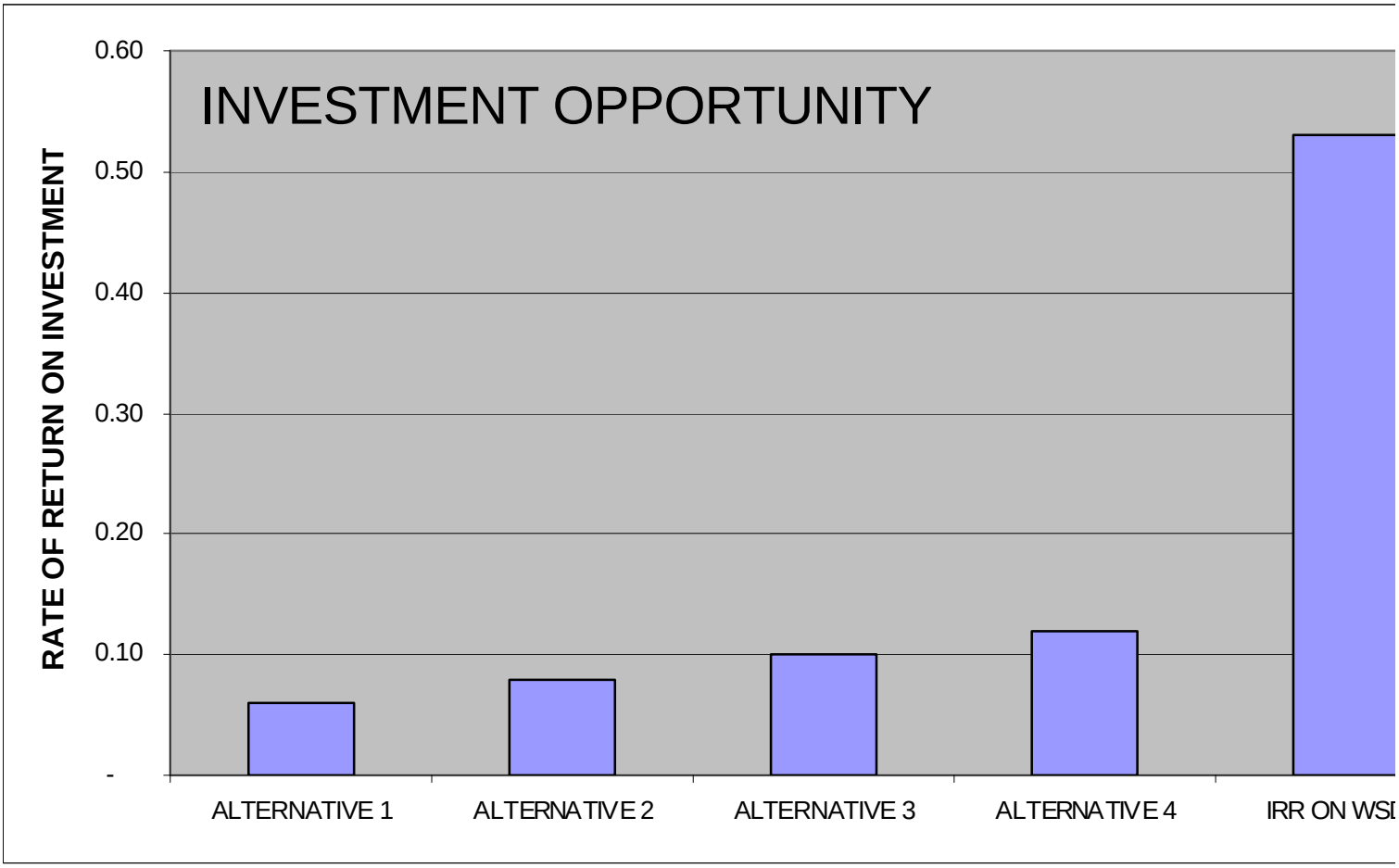


Figure 4.9 Comparison of Internal Rates of Return for Different Alternatives with that on WSD

Chapter 5
ASSESSMENT OF THE SUPPLY SIDE OF WSDs SECTOR

5.1 Background and Previous Studies

5.1.1 Universal WSD Study

In 1995-1996 the Ministry of Water and Irrigation funded by USAID supported a Study of Water Saving Devices (WSD Study) by the Universal Engineering Consulting Group of Amman, as part of the Jordan Environmental Society (JES) project. In June 1995, Cartelle Associates, a subcontractor to Universal prepared a Local Market Survey that was completed in October of 1995. The Cartelle Survey identified 392 selling outlets, suppliers and manufacturers including wholesalers and retailers from a directory of companies listed by the Amman Chamber of Commerce. A short list of 25 was contacted who either was aware of or had actually dealt in WSDs. The WSD Study reported that 8 companies had WSDs in stock or could arrange import within a week. The Universal report also identified 12 local companies registered as manufacturers of sanitary ware, one of which is a local company who agreed to modify their lines to fit WSDs to their products. Universal also identified a Jordanian inventor of a flow restrictor that the Study recommended as a device to use in 1995-1996.

The WSD Study revealed many problem areas facing suppliers, importers and promoters of WSDs in Jordan. Most consulting engineering firms, suppliers and large customers (with the exception of the Five Star Hotels) were unaware of WSDs. Many of those who were WSD aware were put off by the prices and were not convinced of their benefits. Part of the skepticism was fueled by a lack of knowledge as to how to adapt WSDs to differences in water pressure. Many of those who were aware complained of a high rate of silting and scaling of Jordan water which clogged WSDs. Preventive maintenance of WSDs is very simple but apparently not followed. The greatest obstacle to using WSDs in 1996 however was felt to be the 67% Jordanian Customs tax.

The Cartelle study also identified 71 US manufacturers and suppliers of WSDs and received responses from 20 of them showing an interest in Jordan. In 1996 there were no locally available US-manufactured WSDs in Jordan but as a result of the interest generated by the study, one company is now carrying a full line of US products. Cartelle identified several suppliers from European countries such as Germany, Italy, France, the UK and Switzerland. JES in turn developed a list of 9 companies that sell WSDs in Jordan. However those contacted by WEPIA complained that they were not able to sell many of either high quality, expensive European WSDs or even inexpensive WSDs from Asia or Eastern Europe. In spite of the change in government tariffs, retailers in 2000 were still not able to sell in any volume.

5.1.2 WEPIA Update of Universal Study

Jordanian manufacturers visited by the WEPIA team are also not doing well. The one referenced in the WSDs Study is in receivership and others are doing poorly. The WEPIA team was told that poor management was the problem and that Jordanian manufacturing managers do not pay enough attention to legal requirements and have not modernized their lines. One manufacturer felt that dumping of cheap Asian low quality plumbing products was hurting them the most. However, large importers such as American Standard, Ideal Standard and Niagara appear to be faring better as the new five Star Hotels are outfitting their new buildings and renovating with WSDs and water saving

appliances. Jordan Ceramic Company and their affiliates are optimistic that they can improve their product lines to be more water efficient with technical assistance and long-term investment loans Large manufacturers are poised to expand their Jordanian WSDs manufacturing for export. One Jordanian industrialist interviewed by WEPIA team is conducting a personal campaign to introduce the double flushing toilet system into Jordan and recently invited a WEPIA staff person to accompany him on a visit to select European manufacturers.

5.1.3 MWI use of Universal Study

The MWI has used the WSD Study as a basis for publishing a booklet on WSDs entitled "Water Consumption Saving Devices". The Ministry has also been encouraging the use of WSDs with local managers and consumers and have produced a study " The Domestic Use and Percentages of Savings, facts and numbers" under WAJ and the Directorate of Information and Water Awareness on how low cost WSDs could greatly reduce the wastage of water in Jordanian residences. While this study is essentially a desk-top study with estimations of water use rather than actual figures, it represents a good faith effort on the part of MWI to increase awareness of the issue. The MWI Directorate of Information and Water Awareness has recently launched an intensive media campaign promoting WSDs on TV and in local newspapers but has, at the time of this writing, made little visible impact in terms of sales of WSDs reported by suppliers.

5.2 Boundaries/Constraints

The lack of knowledge in the market place of vendors, sales people and customers, as well as the low availability of WSDs and high costs represent the major constraints on the wider use of WSDs in Jordan. Vendors generally do not advertise as their advertising budgets are minimal. Reluctance to spend money on the part of consumers is another constraint that requires regulation and enforcement.

5.2.1 Knowledge of WSDs

5.2.1.1 Knowledge of WSDs in the Market Place.

In spite of USAID's past efforts and the continual effort by the MWI to promote the use of WSDs in Jordan, the WEPIA survey has clearly shown a general lack of knowledge of WSDs and their potential in the market place. Even after the drought years, retailers, wholesalers and importers are more reluctant than ever to invest since they are getting very little demand from the consumer for purchase of WSDs. Some of this can be explained by the USAID/Forward study, "Willingness and Ability to Pay" which indicated that individual frustration at the irregularities in the water supply system, spills over into ambivalence about water conservation particularly amongst males. Some retailers are well informed and are willing to promote WSDs (one has a sign in his window in Arabic "WSDs sold here"). Many businesses that sell water-using appliances such as dishwashers and washing machines however are unaware of WSDs or even their own product's capacity for being water efficient. They usually sell on the basis of style, even price is secondary. For example, front-end loading washing machines are more efficient than top loading; nevertheless dealers will sell the top loader because the technology is newer, more convenient and fashionable. Style comes first, cost is second and water efficiency is third.

Retailers' customers rarely ask for WSDs. The ones who do ask are usually large hotels, hospitals or high occupancy building owners. Sales people feel customers who are in economic difficulty are not interested in hearing about the value of WSDs but worry about other things that the sales people feel are more important. A salesman will rarely tell the customer that the water appliance is a money saver or a water waster. The economic advantage of a water saving product is not a question the customer is led to ask or the sales person usually brings up.

5.2.1.2 Knowledge of WSDs Amongst Customers.

Customers are not convinced that the WSDs save them money. Most of the customers would rather pay a higher water bill than invest in a WSD shower head or other device. There are three types of customers: those not convinced, those unaware and those who are aware but they simply do not want to pay for the WSDs up front. Some retailers are creatively marketing WSDs. For example, one company will give customers WSDs, install them and have customers pay after three months when the water bill comes and they find out that they saved water and money. These suppliers are rare and often the customer rejects even this creative approach.

Attitude sometimes is more important than knowledge. There are even some customers who when given free WSDs will not take time to install them and some luxury minded people who will remove the WSDs because they take too much time or do not feel or look right. People do buy brand names because they feel they can get spare parts and replacements and trust the company to guarantee them. Customer's attitudes towards costs are based on ownership. The general rule is that people who own their own home, especially expensive ones, might be willing to spend money on WSDs but those who are building for the rental market or selling on speculation do not want to invest. The same is true for hotel owners who ignore recommendations to substitute luxury items in the budget for WSDs or even include WSDs as cost-savers in the long run. Discussions with one major engineering firm suggests that the engineering firms do understand the requirement to include water conservation measures, so do the engineering staff of the facility but are overruled by owners looking for cost-cutting measures. Arabtech Jardaneh has gone so far as to construct a gray water re-use system into some of the hotels it has designed, but the systems remain inoperational due to lack of interest on the part of owners.

5.2.1.3 Misleading Information

Sales people often do not know enough to sell the right product. For example, some will sell aerators or aerated faucets without consulting as to the customer's water pressure, consequently selling a WSD that does not work well or later requires an additional expenditure for a pump to make it work. When it doen not work well the customer removes it and persuading him/her to place a second WSD in its place becomes twice as difficult. Customers themselves are often unaware of the requirements of their own facilities and therefore cannot help salespeople even when the salesperson is informed and wishes to be accurate.

5.2.2 Availability

The WEPIA survey of the demand for WSDs for large consumers such as hotels, hospitals and

government buildings reveals a very complex web of variables that must be taken into consideration to predict the right supply needed. Buildings are equipped with makes and models of many different brand names from many different countries thus making it difficult for the supply side to determine what specific WSDs fit the real demand. Merchants try to guess (see Tables 5.1.a, and 5.1.b) with limited resources, and raerly want to gamble on what will work or will not work! Importers who deal with large new constructions have a better grasp of the kind of WSDs needed and therefore can plan and purchase products with more certainty. The most popular WSDs are from Italy, the US and Germany and have relatively high prices compared to Asian-made WSD products that are of limited variety. Few locally made WSDs were found in the 18 supplier survey sites. One manufacturer manufactures a plastic restrictor as a WSD, but given the water quality, WEPIA does not recommend these. Even when they have WSDs, most companies prefer to sell complete sets such as shower units rather than shower heads.

The WEPIA team of surveyors visited 38 different suppliers for sanitary ware in the city of Amman and 59% of those suppliers were selling WSDs for different applications. The availability of common WSDs such as aerators are shown in Figure 5.1 as to the range of costs for WSDs in Amman's leading vendors.

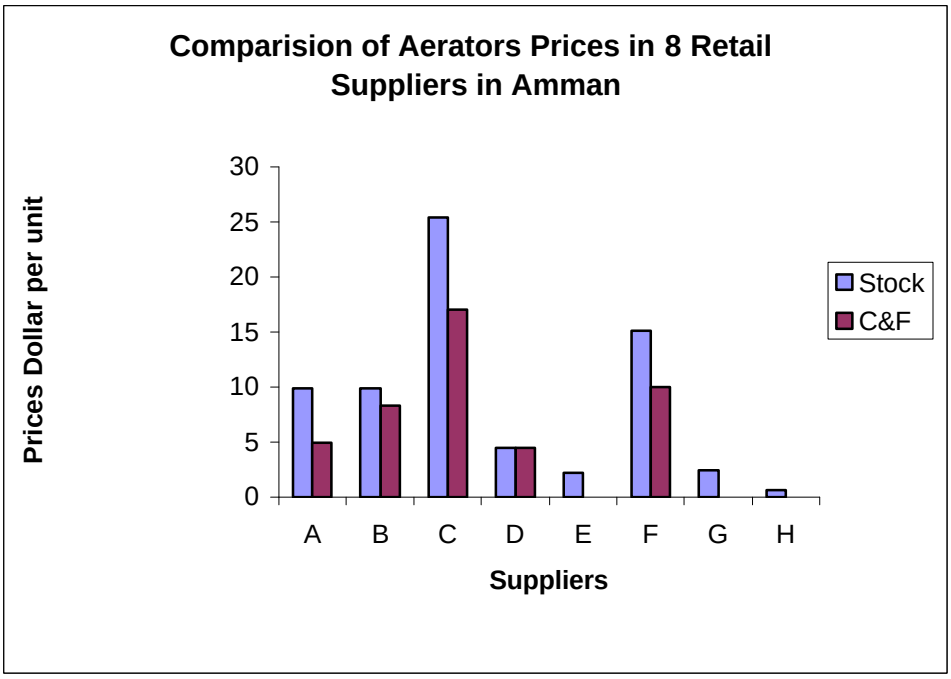


Figure 5.1 Comparison of Aerator Prices in Amman.

5.2.3 Cost

The stock and C&F (cost plus freight) prices vary greatly from dealer to dealer and depend on the country of origin and quality. WSD prices also vary from type to type. The WEPIA survey found a variety of WSDs in the Amman market place. In most cases, the mark up was high because the volume of sales was low.

Surprisingly, the prices of WSDs in the marketplace have not come down since 1996 in spite of lower tariffs and favorable currency balances with Europe; therefore price is still the major

constraint. Costs of all WSDs were noted at their retail price. The prices of common WSDs such as for aerators, low flow shower heads and other recommended devices could come down significantly if there was a greater demand.

5.2.4 Policy Effect on Costs of WSDs

Jordanian Customs duties have been significantly reduced since 1996, thanks to efforts by the Ministry of Water and Irrigation, but they are still figured on the total cost of shipment (C&F) with a new sales tax on top of the tariff making importation of WSDs expensive. There are also hidden fees that merchants complain drive up the costs. The Customs process is very confusing to merchants and much misunderstanding of the approval process still exists. The WEPIA team found the Customs Department and MWI to be very helpful but there were still conflicts over whose policy was in actual use. A fuller description of the policy issues is described in that chapter.

5.2.5 Role of MWI and Customs on WSDs

The Director of the Customer Service Department in the Ministry of Water and Irrigation is responsible for WSD approval in the MWI. The Ministry of Finance and MWI formed a committee to define devices that may be called WSDs for full exemption from duties. The MWI's Custom's report includes the results of experimenting with WSDs in Jordan and some statistical information about the number of faucets, showers, toilets and washing machines. The MWI's approved list and examples of WSDs for importing and applying are also included in the report. The Minister of Water and Irrigation and the Minister of Finance circulated a notice in January 1999, which was published in the local newspapers, explaining the amendment of the Custom's tariff regarding WSDs under the condition of having a recommendation from MWI. Still many vendors of WSDs do not understand the policy which has recently been amended by Customs, eliminating the role of the MWI.

The following items of WSDs are exempted from duty:

1. Auto shut valves such as spring shut and photocell shut valves. Aerators are duty free.

2. All materials that are used for the industry of sanitary ware that is imported by factories are considered production matters and are subjected to customs of 5%.

3. Anything else is subjected to customs of 30%.

4. Any other WSDs not mentioned in the above items used to be subject to the recommendation of the Ministry of Water (MWI) for a duty exemption and waiver. These waivers were obtained after certification by the Jordan Scientific Society that the item was indeed a water saver. This system, as stated above is no longer in service and Customs makes its own determination of what is and is not a WSD based on a review by a committee it has established. It may or may not refer the item to the MWI.

N.B. While items are duty free or of a certain value they still are perceived by vendors to have other kinds of taxes such as a general sales tax attached to the final price. It is this combination of new taxes plus the lowered duties that has kept the price of WSDs high.

5.3 Methodology of Survey

The suppliers surveyed were divided into three major categories: Importers, Manufacturers and Retailers and a representative number of suppliers were selected from each category. Members of the WEPIA team visited all selected suppliers, and suppliers were asked to respond to a survey form (see appendix) indicating the needed information regarding WSDs.

5.3.1 Criteria for Selecting WSDs Vendors

The Supply Side team reviewed the list of locally registered companies supplying sanitary ware and/or plumbing equipment or fixtures from the Universal study and the list of the companies that import and/or distribute water saving devices, from the Jordan Environment Society (JES) list. In order to update the information, the team prepared lists of the latest suppliers of WSDs in Jordan from various sources including the Amman, Irbid and Aqaba Chamber of Commences (Appendix). Other details about the retailers and manufacturers were available from the website www.aci.org.jo. The WEPIA teams reviewed the lists and selected retailers, wholesalers and manufacturers and then made recommendation of the 26 "dependable" vendors to be surveyed. This survey focused on the water saving devices (WSDs) for toilets, urinals, showerheads and faucet aerators although this survey also gave attention to washing machines and dishwashers.

The criteria of selecting a supplier were based on their dependability, which was reflected primarily by their reputation and history in the water business. Those local firms that represent international companies were deemed dependable. Companies, who have a wide variety of products, also had high priority. Companies with well-stocked warehouses were preferable. Those that sell quality goods rather than cheap ones or at least compromise between durability and economy were also rated high. The sales manager's confidence, knowledge about and interest in WSDs was important as was their motivation to make the WSDs attractive by creative sales policies. Customers' faith in the company and knowledge they will be in the WSDs business for the long run was important. As was trust in the ethics of company, if known.

The survey effort of 18 sites by the surveyors to get a complete picture of the supply side was not enough. For example important information on costs was not forthcoming. Of the 18 sites, 8 were local retailers, 3 wholesalers and 5 both wholesales and retailers. The team also visited two manufacturers. It was also clear that several of the firms did not know or care about WSDs. Of the 18, 5 were washing machine and dishwater retailers who had no knowledge of WSDs and even some erroneous ideas about water efficiency. The two manufactures, one of which produces ceramic tanks and the other six kinds of faucet aerators, staff is not aware of the ratings of their products for water efficiency. Of the remaining retailers, two have a wide variety and knowledge of WSDs while the third would be interested in more information. The three retailers and wholesalers have ample supplies of WSDs but only a moderate knowledge of their workings.

To remedy this, the WEPIA team revised the Marketing Survey with the assistance of Cartelle Associates. A telephone survey was made to check the suppliers in the major cities in Jordan, revealing that Amman is the main market source for supplying WSDs to the private sector. Therefore, the second round of market research was restricted to the city of Amman.

The revised survey was targeted to importers and those wholesale and retail merchants who would

likely make a short list for the WEPIA. The WEPIA team revisited approximately 80% of the first group to get better-cost figures and to find out more details of their product lines. The also visited twenty additional importers and other large retailers for a total of 38 sites, the new sample was as follows: 15 retailers, 4 manufacturers and 19 wholesalers and importers.

5.4 Existing Conditions

Tables 5.1.a, and 5.1.b show the output of the survey of the Jordanian market.

Item / Business name	Sink Faucet				Bidet Fuacet				Shower mixer				Shower head				Aerators				Other WSD's			
	Stock price($)	C&F price($)	Availability	Origin	Stock price($)	C&F price($)	Availability	Origin	Stock price($)	C&F price($)	Availability	Origin	Stock price($)	C&F price($)	Availability	Origin	Stock price($)	C&F price($)	Availability	Origin	Stock price($)	C&F price($)	Availability	Origin
Bandar &Sata'an Alhasan	98.9	49.4	Y	G	98.9	49.4	Y	G			Y	G					9.9	4.9	Y	G	**706**	**353**	**Y**	**G**
	141	**70.6**	**Y**	**G**																				
Taleb Darwazeh	63.6	42.4	Y	F	63.6	42.4	Y	F	25.4	17	Y	F												
Metri Muna	91.8	60.7	Y	G	91.8	60.7	Y	G	184	123	Y	G									**169.5**	**113**	**Y**	**G**
Irshaidat Co.													9.89	8.33	Y	U	3.53	2.97	Y	G	**6.35**	**5.37**	**Y**	**U**
													11.3	9.6	Y	U	4.94	4.19	Y	G	**10.6**	**9**	**Y**	**U**
Shraim																								
Kayyali	148	96	Y	G	151	98	Y	G	220	143	Y	G	25.4	17	Y	G	11.3	7.3	Y	G				
	137	89	Y	G	147	95	Y	G	212	138	Y	G	102	67	Y	G	21.2	14	Y	G				
	73.4	48	Y	G	90.4	59	Y	G	107	70	Y	G	102	67	Y	G								
	31.1	20	Y	G	102	66	Y	G	59.3	39	Y	G	212	138	Y	G								
Al-Rawnaq hardware													14.1	14.1	Y	G	4.2	4.2	Y	G				
													12.2	12.2	Y	G								
													4.5	4.5	Y	G								
Mahmoud Abu Ghallous																	2.21		N	I				
International United Est.	32.5		N	I																				
	63.5		N	I																				
	70.6		N	G																				
Al Banan	35.3	?	Y	I	35.3	?	Y	I	38.1	?	Y	I									**3.88**	**?**	**N**	**C**
	28.8	?	Y	C	28.1	?	Y	C	31.1	?	Y	C												
Roboo' Al Ordon	12.7	?	Y	I																				
Al-Assmar	5	4	Y	I													15.5	10	Y	S				
Khalifa Industrial Company	35.5		Y	J	35.5		Y	J	49.4		Y	J												

Home List

I	Italy	T	Turky	G	Germany	J	jordan	C	China	S	Spain

WSD Supply in the local market (Importer)

Table 5-1a

Item / Business name	Sink Faucet				Bidet Fuacet				Shower mixer				Shower head				Aerators				Other WSD's			
	Stock price($)	C&F price($)	Availability	Origin	Stock price($)	C&F price($)	Availability	Origin	Stock price($)	C&F price($)	Availability	Origin	Stock price($)	C&F price($)	Availability	Origin	Stock price($)	C&F price($)	Availability	Origin	Stock price($)	C&F price($)	Availability	Origin
Al- Wathbeh Co.																	1.44		Y	G	1.04		Y	G
																	1.19		Y	G	1.5023		Y	G
																	2.39		Y	G	1.2134		Y	G
																	1.12		Y	G	2.8313		Y	G
																	1.06		Y	G	1.3996		Y	G
																	1.39		Y	G	7.8582		Y	G
																	1.13		Y	G				
																	0.59		Y	G				
																	0.69		Y	G				
																	0.59		Y	G				

Home List

I	Italy	T	Turky	G	Germany	J	jordan	C	China	Table 5-1a

** Shraim Co. have Jordanian Trims avalable at a price of 7$ from Stock*

5.5 Findings

- 47% of suppliers were not aware of WSDs even though some of them stocked these devices in their stores.

- The 53% of suppliers who were aware of WSDs indicated that most of the customers are not aware of them and their uses.

- Customers' concerns were mainly on the prices of sanitary ware and fittings, and little attention was given to WSDs.

- Most of the WSDs available in the local market are of brand names, which often means higher prices.

- Most new technology of brand names products have WSDs built in them as standard measures which are often requirements of the country of origin.

- Customers purchase brand names of WSDs because they have a large variety of models and availability of spare parts.

- The suppliers are not encouraged to import WSDs due to the gaps in laws regarding these devices and to the little demand from the customer, the lack of knowledge and high prices. Suppliers are willing to serve on task forces to review regulations and tarriffs.

- The supplier at a specific area usually offers the quality of sanitary wares and fittings that are affordable for the local customers to buy at the specific location.

- Suppliers rarely advertise WSDs. They have limited advertising funds, and WSDs provide limited revenues. Suppliers look to programs like WEPIA to provide education and interest to the public in WSDs.

- Suppliers are more than willing to collaborate with programs like WEPIA to encourage the public to purchase and install WSDs.

- Suppliers are willing to provide free maintenance and free audits if they feel there might be a sale following the audit.

- Suppliers are convinced that only policy and regulation will convince consumers to purchase WSDs and are willing to serve on task forces to assist in policy creation

- There are no waterless urinals currently being supplied to the Jordanian market.

- There are few suppliers of domed aerators and pressure stabilizing aerators which are the types most recommended for this region.

- Most products produced locally or overseas have no markings to distinguish their capacity. It therefore becomes very difficult for customers to determine which is and which is not a WSD--toilet tanks do not mark their water capacity; toilet bowls do not mark how

much water is necessary for a proper flush.

- The more expensive imported shower heads include aerators and flow restrictors e.g. Grohe.

- Locally manufactured pipe products such as faucets which are made of brass and are manufactured without threads, make it impossible to add an aerator thus requiring replacement of the entire faucet. These faucets are often preferred by Government purchasing agencies because they are locally manufactured and cheaper in cost.

- Manufacturers of ceramic products did not take into account the relationship between the toilet bowl and the amount of water being flushed when they adjusted the size of the water tanks for toilets, hence locally manufactured products will not be recommended.

5.6 Recommendations

- There is a need for a focused public awareness program for vendors, general public and plumbers on WSD availability, appropriate kinds and cost.

- There is a need for bringing suppliers and owners of buildings in specific sectors (e.g. hotels) to a vendor's market to make sales.

- Suppliers should serve on water audit teams for each public building scheduled for retrofitting by WEPIA. .

- WEPIA needs more sophisticated tools for measurement of demand should it be required to purchase WSDs on a large scale.

- Suppliers can and should be involved in training of maintenance and janitorial staff in maintenance and proper upkeep of WSDs.

- Manufacturer's need technical assistance to re-tool their production lines to conform to new standards

- Manufacturers and suppliers need to be responsive to standardization of products.

- There is a need for a WEPIA/WSDs marketing program to compliment MWI, LEMA and other efforts.

- There is a need to clarify Customs rates and procedures for vendors.

- There is a need to harmonize the action plan for buying and installing WSDs for Government buildings to maximize what is available locally.

- A "Consumer Report" on availability of high quality and low price WSDs for Jordan would be helpful to vendors and customers.

Table 5.1.A Amman Businesses Surveyed By The Supply

No.	Business Name
	Wholesalers / Retailers
1	Tahboob Brothers Co
2	Zakarneh Co.
3	Wajeh Qasem
4	Izzat Mussa Marji
5	Masher Brothers Co.
6	Samir Ghusain
7	Darwish Khalili Sons
8	Al Asmar and Al Lathqani
9	Global Center for American Products
10	Zuhair Issa Murad Co.
11	Mitri Mushahwar and Sons
12	Abdelkarim Alkayyali
13	The Engineers
14	Irshaidat Co.
15	Khurma Co.
16	Al Qayrawan
17	Taleb Darwazeh
18	Issa Murad Co.
19	Al Mehwar
20	Saleem Khalil
21	Al Moselly
22	Petra Co.
23	Al Muna
24	Al Wathba Inv. Ltd
25	Al Asmar
26	Bandar and Saatan Al Hasan
27	Roboo Al Ordon
28	Mohammed Abu Ghallous
29	Al Rawnaq Hardware Store
30	Al Alamia
31	Al Banan Est. for Trading Sanitary Ware
32	Tadmor
	Table 5.1.B List of Local Manufacturers
1	Shraim Co.
2	Arab Ceramics (Zakarneh Industry)
3	Jordan Ceramics
4	Kayyali Industrial
5	Amman Casting Co.
6	Khalifa Industries

Chapter 6
EVALUATION OF THE POLICY AND REGULATORY ISSUES AFFECTING THE USE OF WSDs IN JORDAN

6.1 Introduction

Water is scarce in Jordan and demand is currently outstripping supply. Water conservation or demand management is less costly and better for the environment than alternatives to augment the existing water supply such as desalination or water importation. Conserving water is economically sound as it reduces the cost of water that needs to be stored, purified, treated, distributed, and treated again as wastewater. Indeed, it is estimated that water saving devices can reduce water consumption by 35 percent.

The current body of Jordanian water laws and regulations stipulates that there is a need to conserve water; however, it does not specifically address the use of water saving devices (WSDs). The legislation neither provides a clear definition of water conservation nor does it provide directives for enforcing the water conservation provision. Additionally, there are no specifications in local building codes mandating the use of WSDs, and there are currently few government incentives for encouraging water consumers to retrofit old buildings with WSDs. The Ministry of Water and Irrigation (MWI) recently amended the Customs Duties Law in order to exempt certain WSDs from customs, which was an important step in the direction of providing incentives to WSDs suppliers. However, due to a host of complicated application procedures and a concurrent rise in the sales tax on these fixtures, the amendment to the Customs Law does not promote the importation and widespread use of WSDs as much as it potentially could.

This chapter examines the laws, policies, and regulations relating to water consumption and distribution in Jordan, as well as the building codes, customs, and sales taxes on the importation of plumbing fixtures. The chapter also reviews law and incentives in the United States in an attempt to provide examples of best practices relating to water conservation and the use of WSDs. Additionally, the chapter presents recommendations for changing some of the regulations, policies, and practices relating to water in Jordan.

6.2 Water-Use Legislation in Jordan

Water use in Jordan is governed by a number of laws, regulations and codes. The current laws include:

1. The 1955 Municipalities Law No. 29
2. The 1960 Penalty Law No. 16
3. The 1966 Law of Cities, Villages and Buildings Organization No. 79
4. The 1971 Public Health Law No. 21
5. The 1973 Law of Agriculture No. 20
6. The 1985 Industrial Cities Law No. 59
7. The 1988 Water Subscription Law
8. The 1988 Water Authority Law No. 18
9. The 1988 Development of Jordan Valley Law No. 19

10. The 1995 Civil Defense Law No. 12
11. The 1995 Environment Protection Law No. 12

In general, these laws are broad and do not include specifics about acceptable amounts of water for consumption in the various sectors, nor do they include examples of conservation measures. For example, Article 6 of the 1998 Water Authority Law No. 18 stipulates that the Water Authority of Jordan should conserve water resources; however, the article does not expand upon which conservation measures to implement or how much water to conserve. This article is the only reference to the importance of water conservation in the relevant body of water legislation.

Many articles in the 1995 Environment Protection Law No. 12 outline penalties for polluting public water; however, there are no comparable penalties listed for overconsumption or a failure to conserve water. Similarly, the 1960 Penalty Law No. 16 does not designate penalties for wasting water. All articles with respect to water issues in this law deal with general crimes relating to the water system in Jordan, such as actions that would negatively affect public sources of water.

Water in Jordan is supplied to consumers on the basis of a contract that is signed by both the consumer and the Water Authority of Jordan pursuant to the 1988 Water Subscription Law. This law does not currently mention WSDs; however, the law does stipulate that domestic consumers must not exceed 75 cubic meters per cycle. This contract also gives the Water Authority the power to cut off a subscriber's water supply for over-consumption, for failing to do preventative maintenance (such as fixing leaks), or for tampering with the water network or the water meter. Moreover, the Secretary General of the MWI is authorized to cancel a consumer's water subscription if the subscriber repeatedly violates one of the aforementioned regulations. The existence of these regulations and penalties is important as it demonstrates a commitment to ensure that consumers conserve water. However, in practice it is clear that the stipulations of this law are not universally enforced. It is estimated that 30,000 water consumers around the country are either non-paying users or are paying substantially less than they consume due to the fact that this law is not rigorously or uniformly implemented. This illegal use results in an enormous waste of water and the loss of a large sum of money each year. Currently, illegal water users have relative impunity and therefore no incentive to pay for or conserve water. Infractions involving water use are deferred in the courts, and most cases are not tried for years, if at all. Indeed, enforcement of the Water Subscription Law, as well as of any new regulations regarding water-efficient fixtures and water conservation should be a top priority.

6.3 Legislative issues related to WSDs

Current building codes do not mention water saving devices. For example, the 1966 Law of Cities, Villages and Buildings Organization No. 79, delineates certain rules and regulations regarding building in general and the establishment of sewage and main plumbing systems. This law does not include directives for maintenance on the inside of the building. Thus, according to this law the authority of the governorate is limited to the main structure, the location, and the external structure of a building.

The authority of the Building Licenses Directorate is limited to establishing the external designs and plans of buildings and this body does not have authority to set specific plumbing standards. The 1994 Standards and Measurements Law No. 15 establishes guidelines for plumbing systems. This law outlines the lowest storage capacity for different types of public and private buildings. The Standards and Measurements Law also outlines some general conditions for storage tanks and for

the lowest required flow rate for various plumbing fixtures. However, the law does not outline water efficiency requirements, nor does it mandate the use of WSDs.

On the other hand, the 1955 Municipalities Law No. 29 stipulates that "one of the tasks of the municipality council is to provide people with water, and to determine the specifications of the needed equipment, plumbing and meters and to organize distribution, price and subscription fees of water …". Pursuant to this clause, municipalities should have the power to devise and enact regulations about the mandatory use of WSDs for all new buildings and structures; however, at present they do not do so.

6.4 Customs Duties and Taxes on WSDs

The 1998 Custom Duties Law No. 20 does not specifically mention WSDs; however, in an attempt to promote water conservation, the Ministry of Water and Irrigation passed an amendment to this law, which stipulates that certain plumbing fixtures, including some WSDs, will be fully or partially exempt from customs.

The MWI published a list of about 17 acceptable WSDs and the Minister of Finance and the Minister of Industry and Trade agreed to exempt customs on the importation of some of these WSDs. This agreement was approved by the Prime Ministry and was published on page (133) of the Official Newspaper No. 4319 dated 16/1/1999.

Prior to March 2000, any person or institution that wished to receive an exemption on a WSD had to submit a detailed petition to the Ministry of Water and Irrigation. The MWI then referred the petition to a technical committee, which determined whether or not the products were actually WSDs and therefore subject to the exemption. If the committee concluded that the device was a WSD, it wrote a letter of exemption to the Customs Department at the Ministry of Finance.

Following Jordan's accession to the World Trade Organization in March 2000, certain regulations required that the process for requesting and receiving a customs exemption be changed. Currently, vendors of WSDs are required to directly approach the Customs Department with their request for an exemption. An internal Customs Department committee reviews the request and makes a decision about whether or not the fixture is a WSD. The committee may ask the MWI representatives to provide an advisory opinion; however, it is authorized to make the final decision regarding customs exemption. The Customs Department uses a short list of acceptable criteria to determine whether or not a fixture is considered a WSD. According to this list, the following items receive 100 percent exemption:
Self shut-off valves used for water taps to reduce water consumption.
Parts of cocks and taps, designed to reduce water consumption.

All other (whether water efficient or not) "valves, taps, cocks, and similar appliances for pipes, boiler shells, tanks, vats or the like, including pressure-reducing valves and thermostatically controlled valves" receive a 30 percent customs exemption.

Given the vague specifications for WSDs and the recent change in the application process, it is easy to understand why potential vendors of WSDs report being confused by the application process, and sometimes are dissuaded from requesting an exemption.

Furthermore, although certain WSDs are currently exempt from customs duties and tariffs, they still are subject to other taxes such as the general sales tax. In fact, the sales tax on these and all other imports was raised from 10 percent to 13 percent in July 1999. Moreover, there is currently no differential tax structure for plumbing fixtures. In Jordan, suppliers and consumers pay a flat tax on all local and imported goods except on "luxury" items such as alcohol and cigarettes, which are subject to an additional excise tax. Thus, vendors of plumbing fixtures pay the same general sales tax on WSDs as they do on inefficient fixtures. As a result of the current tax policy, importers of WSDs ultimately pay the same or slightly more than they did before the customs exemption was implemented. The recent customs exemption policy was clearly intended to be an incentive for the importation and use of WSDs. However, the confusing process for applying for an exemption, and the simultaneous rise in the sales tax have not had this effect.

6.5 Penalties and Incentives

As previously mentioned, much of the current legislation and regulations with respect to water conservation issues lack clear and specific penalties for misuse of water or incentives for water conservation, and the provisions that do exist have proven difficult to implement.

The Ministry of Water (MWI) and Irrigation recently implemented a program that delineates specific penalties for wasting or misusing water. This program includes fines, cutting off water, and shifting the water consumer from one price category to another. For example, if the consumer is using more than 185 cubic meters per month (for consumers within Greater Amman) or 135 cubic meters per month (for consumers outside Greater Amman) s/he would automatically be shifted to the higher price category.

While the MWI and it's staff have considered several incentives such as rebates and special financial considerations for low water consumers, no final decisions have yet been made.

6.6 Synopsis on Legislative Practices in the USA

In 1992 the United States Congress passed the Energy Policy Act, which established uniform water efficiency standards for virtually all toilets, urinals, showerheads, and faucets manufactured after January 1994. The requirements are administered and regulated by the U.S. Department of Energy through its Office of Building Technologies. The maximum water use allowed for any showerhead manufactured after January 1994 is 2.5 gallons per minute when measured at a flowing water pressure of 80 pounds per square inch. The maximum water use allowed for lavatory faucets, lavatory replacement aerators, and kitchen faucets is also 2.5 gallons per minute. Metering faucets must be 0.25 gallon per cycle. All gravity tank-type toilets, flushometer tank toilets, and electromechanical hydraulic toilets manufactured after 1994 must be 1.6 gallons per flush, urinals must be 1.0 gallon per flush, and blowout toilets must be 3.6 gallons per flush. The Energy Policy Act also mandated that all plumbing fixtures be clearly labeled so that suppliers and consumers can see that the products comply with the new federal standards.

As a result of the Energy Policy Act, policymakers predict that by the year 2026 water consumption for an average American family will be reduced by half, as the pre-1994 plumbing fixtures are replaced by the mandated water-efficient fixtures.

In addition to mandating labeling requirements and maximum water use standards for plumbing fixtures, the Energy Policy Act also recommended incentive programs for state and local governments to accelerate voluntary fixture replacement in buildings that were constructed prior to 1994.

In water-scarce cities across America, local governments have implemented various incentive programs with a great degree of success. These programs include: offering rebates on the purchase of low-flush toilets, distributing and installing free (or subsidized) water saving devices, and implementing leak detection and repair programs. In each of these cases, local governments determined that a permanent reduction in water consumption was necessary and that the long-term environmental and economic benefits of reducing water use far outweighed the cost of implementing the program. One illustrative example of these incentive programs is the ultra-low flush (ULF) toilet rebate program in Santa Monica, California. In this case, the city provided two financial incentives for ULF retrofitting—offering a rebate to cover most of the costs of ULF toilets and installing low-flow showerheads free of charge and exacting a surcharge on customers who do not retrofit. After conducting a feasibility study and changing city ordinances to allow the city's utilities division to pay rebates and charge fees, the city conducted a public education campaign to publicize the new program. The total program costs will be approximately $5.4 million by the year 2002; however, the net savings are estimated to be $8.5 million by the year 2002. The savings are derived from avoided water purchases, avoided wastewater treatment costs, incentive fees, and avoided capital expansion costs.

6.7 National Standards and Oversight

One of the main barriers to water conservation and the widespread use of WSDs in Jordan, is the lack of national water efficiency standards. Government agencies and public and private water consumers recognize the importance of water conservation. Some of the legislation relating to water use mentions water conservation and even imposes penalties for water misuse. However, there are no universally recognized standards for plumbing fixtures in Jordan. Moreover, there is currently no oversight committee to test plumbing fixtures in order to determine their flow rates, their overall quality, and their suitability for use in Jordan. Plumbing fixtures are not labeled with flow rates, which contributes to an overall lack of vendor and consumer awareness about the water efficiency of available plumbing products.

Some vendors currently import and sell WSDs that are not appropriate for use in Jordan. Due to differences in water pressure between Jordan and other countries (the United States and countries in Europe), some of the WSDs that work very well elsewhere, are not suitable for use in Jordan. Consumers who have purchased these imported fixtures often complain that they are not satisfied and consequently remove them from their taps or showerheads. Additionally, many of the locally made plumbing fixtures are poorly manufactured and are very inefficient. With the development of national standards and an oversight committee to ensure compliance with these standards, the country should be able to phase out both the use of inappropriate imported WSDs and inefficient locally made fixtures.

6.8 Conclusion and Recommendations

There are currently both legal and policy barriers to implementing the widespread use of water saving devices in Jordan. As previously stated, current water laws, regulations, and codes generally suggest water conservation, but do not explicitly impose the use of water saving devices. Similarly, there are no nationally recognized standards for what constitutes a WSD. However, there are no apparent legal constraints to introducing legislation, regulations or codes that would develop national standards and mandate the use of WSDs. Due to the fact that certain policies and practices further impede the widespread adoption and use of WSDs, legal change would have to be accompanied by both national awareness programs and changes in certain policies. The example of the 30,000 illegal water users illustrates that laws are less effective if they are not properly enforced. In other words, mandating the use of WSDs through legislation will be more likely to achieve water conservation goals if it is done in conjunction with an appropriate enforcement mechanism. A comprehensive water conservation strategy should include: changes in current law and policies, development of national standards and oversight, widespread availability and accessibility of water saving devices, incentives for their installment and use, better water management and oversight, and public education about water conservation and the effectiveness of using WSDs. Our recommendations for changes in legislation, regulations, and policy include the following:

Within one year:

1. National water efficiency standards should be established and included in all of the laws relating to water use, customs and taxes, building codes, and plumbing codes.
2. An oversight committee should be established to test suppliers' compliance with national standards.
3. Licenses for new buildings should only be granted to plans that include the new national standards.
4. WSDs should be distributed and installed with water meters for all new water subscribers.
5. The Ministry of Water and Irrigation and the Customs Department should work jointly to clarify the application process for a WSD exemption to vendors of WSDs.
6. The aforementioned national water efficiency standards should be used by the Customs Department to grant full exemption for WSDs.
7. Incentives for the importation of WSDs should be created by applying a higher sales tax on inefficient plumbing fixtures and a lower or no tax on water efficient fixtures.
8. Proposed MWI incentive programs (such as the invoice prorating and monetary rewards program) should be implemented.
9. An MWI committee should review incentive programs for retrofitting old buildings with WSDs in the United States and elsewhere to determine their feasibility in Jordan.

Within three years:

1. All plumbing fixtures should be labeled with flow rates.
2. All locally manufactured plumbing fixtures should comply with national standards.
3. Suppliers should be required to guarantee performance standards for a set period of time. This would help to alleviate the problem of selling inappropriate or faulty plumbing fixtures.
4. There should be monitoring of the effectiveness of all plumbing fixtures, mandatory preventative maintenance, and immediate consequences for consumers who do not comply with water laws and regulations.

5. A separate utilities court with a judge and lawyers who are trained in water law should be established (analogous to a traffic court) so that illegal users would have to face immediate consequences for their infractions.
6. Locally appropriate incentive programs for retrofitting old buildings with water efficient fixtures should be implemented.

Within five years:

1. All buildings in the large water consumer category should be retrofitted with WSDs.

Please refer to Figures 6.1 and 6.2 for an illustration of the process of applying for an exemption both prior to and following Jordan's accession to the WTO.

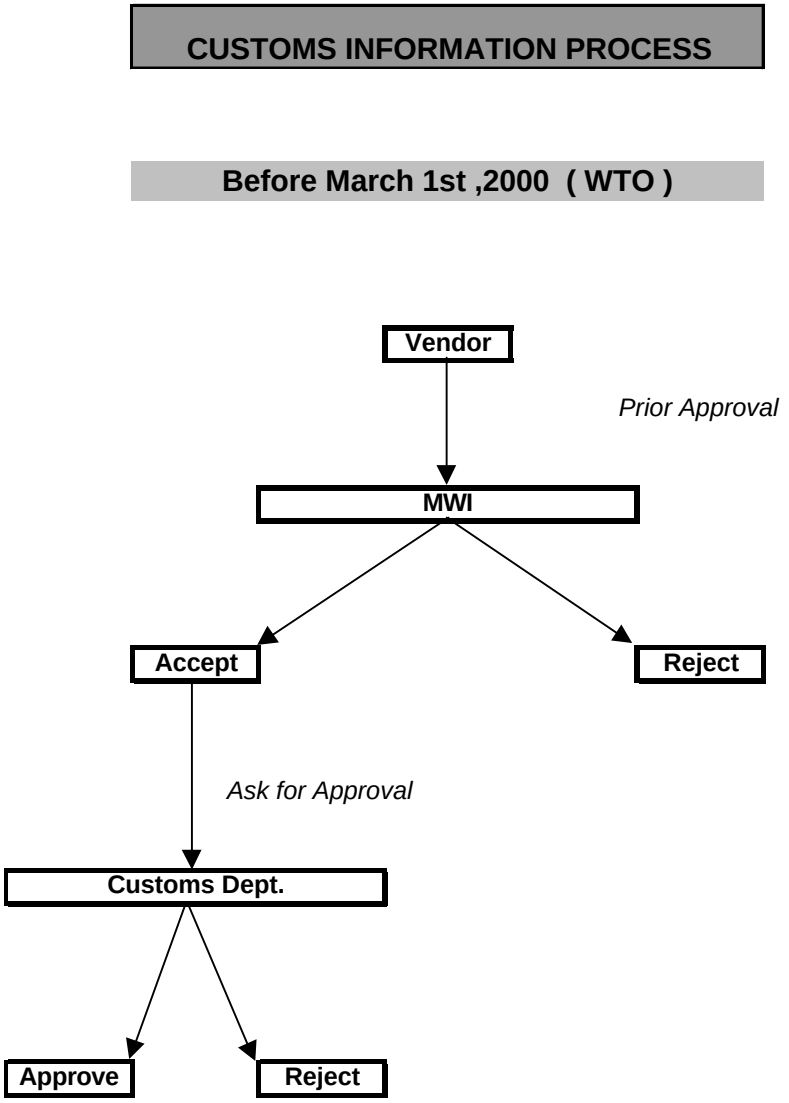


Figure 6.1 Process of Applying for an Exemption Prior to Jordan's Accession to the WTO.

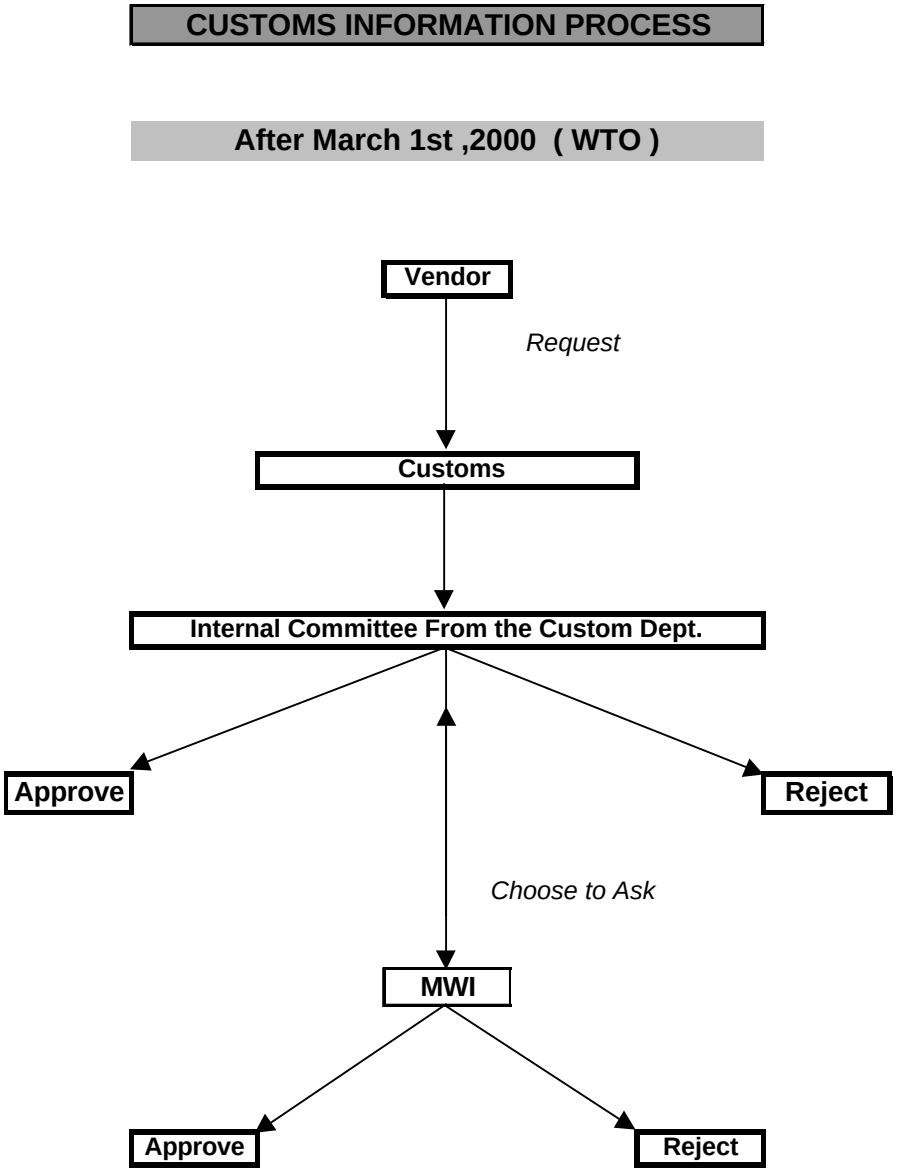


Figure 6.2 Process of Applying for an Exemption Following Jordan's Accession to the WTO.

Chapter 7
POST AUDITS OF NINE SITES RETROFITTED DURING A PREVIOUIS STUDY

Understanding the factors inhibiting the widespread use of WSDs in Jordan is a key step towards achieving the specific tasks outlined for WEPIA. These include technical, financial, and social (behavioral) factors. The relative importance of each of these factors was the focus of the WEPIA's assessment team and was based on available information on the WSD sector in Jordan obtained by independently surveying the consumer demand factors, supplier factors and the policy and regulatory environment. The integration of all pertinent factors together is best evaluated by auditing sites (large water consumers) already retrofitted with WSDs. Such sites are very few in Jordan, and were mainly retrofitted with WSDs in 1996 under USAID funding.

The performance (i.e., success and failure) of the nine sites that were retrofitted as part of the previous study in 1996 is discussed in this chapter. The previous study was requested by the MWI and conducted under the auspices of the Water Quality Improvement and Conservation Project (Contract No. AID-278-0288-00-C-4026-00), funded by USAID/Jordan. Universal Engineering Consulting of Jordan conducted the study and installation of WSDs under contract with Development Alternatives Inc. (DAI), and in collaboration with the Jordan Environmental Society (JES).

7.1 Background

The previous study of WSD use in Jordan (1996) identified nine sites with large water consumption rates for demonstrating the potential savings from retrofitting with WSDs. The criteria used for the selection of these sites emphasized technical conditions that simplified the retrofitting process and touched on the willingness of the owners/managers to cooperate with the study team. Each of these sites represented a category of buildings such as hospitals, schools, mosques etc.

Demonstration sites were retrofitted with different WSDs. For example, WSDs were only installed at the taps of the facilities at Al-Husseini mosque and Al-Salt Girls Secondary Schools, while WSDs were placed at the mixers of wash basins, sinks, shower heads, and toilet flushes in the maternity ward of the King Hussein Medical Center and in the Akkad Luxurious Villa.

Performance of these sites was evaluated immediately after installation by monitoring the water pressure, flow rates, and consumption rates. All sites demonstrated overall water savings after the retrofit. Individual fixture savings were not calculated. However, no monitoring or maintenance took place after that time.

This earlier retrofit program did not consider all possible WSDs but limited itself to a few simple ones. Urinals were not investigated and only one mechanism of toilet flush, WC-water-stop, was investigated. Replacing toilets using an early dual flush system was not considered.

The following subsections present a summary of this study including the reasoning behind the selection of these sites, the selection criteria, and the findings in terms of percentages of water savings.

7.1.1 Site Investigation and Evaluation

During the previous study in 1996, the team selected 9 sites for testing WSDs. These sites were chosen based on a set of criteria that is listed in section 7.2 below and were treated as demonstration sites that represented the following different categories of large water consumers:

Households
Hospitals
Hotels

Businesses

Governmental Buildings
Schools
Mosques
Military Facilities

Water savings of these large consumers were monitored before and after installation of WSDs and the percentage of savings were estimated directly after installation.

7.1.2 Selection Criteria

The following criteria were used to select the demonstration sites:

1. Suitability of installing the available WSDs;
2. Suitability of piping networks (hot and cold water) for zoning;
3. Suitability of installing the available Ultrasonic Water Flow Meters (UFMs) and Conventional Flow Meters (CFMs);
4. Accessibility of the site;
5. Availability of sufficient water pressure in the water distribution system;
6. Water quality, availability of filtered or treated water; and
7. Tendency of site owner/manager to cooperate with the study team.

7.1.3 List of Selected Sites

The following sites were selected, approved and retrofitted:

1. Philadelphia Hotel (currently managed by Radisson SAS);
2. Al-Zeitouneh University;
3. Akkad Luxurious Villa – Deir Ghabar;
4. King Hussein Medical Center;
5. Water Directorate of Amman Municipality;
6. Al-Husseini Mosque/Downtown Amman;
7. A private apartment in East Amman;
8. Al-Salt Girls Secondary School; and
9. Al-Husseini General Depots-Zarqa.

7.1.4 Results of the Study

Based on the results of site monitoring before and after installing the WSDs in the nine sites, the percentage of savings were calculated (in 1996). The outcome of the study (Table 7.1) proved that the use of WSDs in Jordan contributed in solving the water crisis.

Table 7.1 Results of the Study

No.	Site	Saving % with the Use of WSDs	Remarks
1	Philadelphia Hotel	22.6	
2	Al-Zeitounah University	20.6	
3	Akkad Luxurious Villa-Deir Ghbar	27.6	
4	King Hussein Medical Center	33.0	
5	Water Directorate of Amman Municipality	16.1	
6	Al-Husseini Mosque	17.5	
7	Apartment East Amman	20.1	
8	Al-Salt Girls Secondary School	No Saving	Examination period coincided with the monitoring period
9	Al-Hussein General Depots	27.7	

Table 7.1 indicates that water savings from 17 to 33% were anticipated due to installation of WSDs in the above mentioned sites. These observations were based on short term monitoring program that immediately followed the retrofitting program in 1996. The savings of Al-Salt Girls Secondary School were not recorded because a student examination period (duration of about two weeks) coincided with the monitoring program and no attempts were made to take the necessary measurements after the exams.

The cost of WSDs were compared to the cost of water saved, and the estimated payback period was as short as one month at sites with high water consumption in which the upper price range of water tariffs is applicable. The longest pay time period was less than three years.

7.2 Post Audit of the Demonstration Sites

Members of WEPIA's team visited seven of the nine demonstration sites during the period between April 15-25, 2000 to evaluate the conditions of the installed WSDs and benefit from the users/owners experience. Two sites were not visited, the first was an unidentified apartment in East Amman, and the second was not accessible. The following main questions were asked during the interview:

1. Are WSDs installed by JES/MWI still installed at your facilities?
2. Have you noticed/ monitored any savings in your water bills since they were installed?

3. Do you have any recommendations for future WSDs users?

The post audit results are summarized in Table 7.2(a-c).

7.3 Findings of Post Audits

After four years of retrofitting nine demonstration sites with WSDs, Tables 7.2 (a-c) revealed a general disappointing performance of these devices. Three out of the seven sites visited by WEPIA's auditing team has none of the installed WSDs, two lost (disappeared or damaged) most of the WSDs almost immediately after installation, and only two sites (Al-Husseini Mosque and Akkad Luxurious Villa in Deir Ghabar) still have the installed WSDs. Besides, the owner of Akkad Luxurious Villa, one of the two sites that still has WSDs, was unable to decide if water savings occurred because of errors in reading the water meter, and the difficult formula that WAJ/LEMA uses to determine quarterly consumption for consumers between 71-132 cubic meters.

Case Study: WSDs at Al-Huseini Mosque
The taps of all the facilities at the mosque were retrofitted with WSDs in 1996 by UEC and JES. The mosque is used by thousands of worshipers especially at prayer times.

Recently, members of WEPIA's assessment team visited the mosque and inspected the taps that were previously retrofitted with WSDs. All WSDs were found in place despite the extensive use of these taps by worshipers. There may be two reasons for this. The first is because the WSDs were placed behind the taps inside the wall and were not visible or removable. The second may well be that a place of worship seems to be spared from the general vandalism that takes place in other public sites..

This case illustrates that the choice and location of the proper WSDs is at least one key factor for the sustainability of a retrofit program. However, the next case study demonstrates that the choice of the building to be retrofitted is also an important factor to be considered. The change of function of the site may render WSDs useless.

Case Study: Al-Zeitounah University
Selected Sanitary fixtures were installed in a wing of a Women's dormitory, which is composed of a basement, and three floors (two of which were occupied). They were retrofitted in 1996 by JES. WSDs were installed at mixers for washbasins; sink taps, shower heads, and toilet flushes. Each floor consists of student rooms, counselor's residence, and a public toilet in addition to a kitchen and laundry room for the wing.

The audit conducted by WEPIA team showed that none of the WSDs was found in place –all the bathrooms had been converted to classrooms and all fixtures had been removed.

Other main finding of this study included: the lack of an organized follow up program to monitor the sites after the study had been concluded; lack of record keeping for savings, and lack of proper training of the maintenance personnel, and lack of education for employees and users.

7.4 Analysis and Recommendation

The two demonstration sites that still have WSDs provided protection for WSDs from vandalism or potential damage. At Al-Husseini Mosque, WSDs were invisible for potential users because these devices were placed behind the taps inside the wall. The other site (Akkad Luxurious Villa) is private property and is inaccessible to public users. These observations suggest that sustainability of WSD's may be highly dependent on the kind of education program afforded users and maintenance staff. The MRO study, conducted under WEPIA auspices indicates that, as in other countries, Jordanian differentiate between private and public behavior. Where most would not dream of littering their personal homes, or vandalizing their own fixtures, there are nevertheless many who do not carry this concern for property to public spaces. Vandalism is common and rarely reported. Costs for vandalism are not available but suggestions from the study conducted at El-Bashir hospital suggest that they are considerable. A general program to change the public attitude towards caring for public spaces may need to be part of any retrofit program.

Lack of awareness and knowledge about WSDs was evidenced through the responses of the owners/managers of this site. Some sites have no records of the fixtures that had been retrofitted. At least one of the nine demonstration sites (an apartment in East Amman) was never identified.

At King Hussein Medical Center maternity ward, some WSDs were missing or broken. This reinforced the suggestion that monitoring programs should consider protecting WSDs and other fixtures, and revealed a negative attitude of the public towards public properties. On the other hand, the leaking toilets and scale-plugged shower heads indicated a lack of or poor maintenance programs. This may be attributed to lack of training of maintenance staff. WSDs are very simple to maintain. Scaling can be easily removed by soaking the WSD in vinegar, but unless maintenance men are provided with vinegar solution and trained to regularly clean out WSDs they will scale to the point where they prevent easy water flow and are then removed and discarded.

Two sites lost the WSDs installed in fixtures because the buildings themselves changed function. A women's dormitory was converted to classrooms at Al-Zeitounah University and the guest rooms at the Philadelphia Hotel have undergone several renovations at the hands of changed management. In both cases, WSD's were removed, discarded and not replaced. This suggests that any future demonstration site needs to be carefully selected if it is to be monitored over time.

Table 7.2(a) Evaluation of JES Sites

No.	Site	Equipments Location	Points of Installation	Post Audit
1	Philadelphia Hotel (Radisson Sas)	A zone of single bedrooms in 10 floors (one single bedroom in each floor) and a public toilet room on the tenth floor)	Mixers, Showers, and Urinals	(1) Most of the rooms have been renovated except for the 5th and 6th floor. Non of the WSDs that were installed still exist. (2) All new sanitary fixtures installed include aerators (Faucets and Showerheads) (3) New Niagaras installed use around 5-6 liters/flush.(4) Water is pumped to the rooms at 4-5 bars. (5) Some of the equipment installed are made by Jacob Delafon (French manufacturer). (6) Eng. Khaled Alami and Eng . Amer Souber are our contacts and are good sources for information . (7) Hotel water bill was around 71,000 J.D for the year of 1999. (8) Laundry consumed most of their water and since they are about to replace their washing machines we recommended that they should consider buying water -efficient types.
2	Al-Zeitounah University (Eng. Sufian Mar 'i Tel. 4291511 ext. 505)	A zone including a complete wing of the Women 's Dormitory composed of a basement and three floors two of which were occupied . Each floor consists of student rooms, counselor 's residence and a public toilet (5 W.C.'s, 4 basins and 4 showers) and a kitchen , the basement included in the laundry	Mixers for washing basins, sink taps, shower heads , and toilet flushes.	(1) Based on Eng . Sufian Mera 'i (Chief Engineer) none of the WSD 's still exist on site since the building has been converted into classrooms . (2) Currently they get their water supply from a private well. Their average water consumption is 150 m3/day mostly for Irrigation .(3) They are looking currently into building their own wastewater treatment plant and reuse the effluent for irrigation . (4) We also pointed out to them that they should consider rainfall harvesting .

Table 7.2(b) Evaluation of JES Sites

No.	Site	Equipments Location	Points of Installation	Post Audit
3	Akkad Luxurious Villa Deir Ghabar (Tel. 5535310)	Four story Luxurious villa-connected by interior stairs-out of which 3 floors were occupied by the owner's family and basement by the maids, cook, gardeners…etc.	Mixers of washing basins and sinks, showerheads, and toilet flushes.	Based on phone conversation with the owner of the villa, he noted that all the WSDs are still in place but he could not tell if they are saving water by comparing water bills. He thinks that the error in the water meter readings and the unexplainable formula that WAJ (LEMA) are using for the quarterly consumption between 71-132 m3 are making it harder on him to judge. When asked for any future recommendations he showed great interest in having a separate network for sink and showers where it can be stored in an underground water storage together with rainfall collected from roof to be used all for flushing toilets and irrigation. He thinks it is not feasible to have a storage tank for storing rainfall alone.
4	King Hussein Medical Center (Dr. Yasin Husban Tel. 5347584)	Complete maternity Dept. : 10 patient rooms (with Private bathrooms), 4 wards with public toilet rooms, and ten other rooms for labs kitchens, theater…etc.	Mixers of washing basins and sinks, shower heads, and toilet flushes	After inspecting the 7 private rooms in the department, we found several problems mainly: some of the faucet aerators are missing; broken and missing showerheads; showerheads plugged with scale; and leaking toilets. During the visit we met with Dr. Yasin Husban (Director of King Hussein Medical Center), electromechanical Engineer Kaldoun Atiat, and Ali Sarhan from the Public Relation. There are no records of the total number of toilets, showers or faucets available in the center. Their average yearly water bill is around 700,000 J.D. beside the 40 - 50 m3/hr flow rate extracted from their private well.

Table 7.2(c) Evaluation of JES Sites

No.	Site	Equipments Location	Points of Installation	Post Audit
5	Water Directorate of Amman Municipality	A zone of 2 floors (a basement and 1st floor) out of a 4-story building. Each floor consists of 2 complete apartments.	Mixers of washing basins and sinks, showerheads, and toilet flushes.	We visited the site and inspected the first floor sanitary fixture. The mixers still exist but with no aerators. The toilet flushes still exist. The showerheads have been taken out. Mr. Michel Lesbros (Customer Services Director) tried to track down and contact the maintenance engineer who was in charge of the building in 1996 but he could not find any person who recalls the retrofitting operation. The building is going to be rehabilitated soon.
6	Al-Husseini Mosque	Complete facilities of the Mosque	Taps	Based on a site visit to the Mosque and a discussion with Mr. Abdul-Salam Kamal, we concluded that all the WSDs still exist. The DAI and Universal team installed WSDs behind the taps inside the wall to prevent them from being vandalized. They used showerhead type to achieve this goal.
7	Apartment East Amman	A complete ground floor apartment of a 3 story building in Kuwaismah, the apartment is composed of 3 bedrooms, a kitchen and a bathroom.	Mixers of washing basins and sinks, showerheads, toilet flushes.	Not yet audited
8	Al-Salt Girls Secondary school	A zone of separate W.C.'s units building 10 W.C.'s 4 washing basins and 10 drinking taps.	Taps	Not yet audited
9	Al-Hussein General Depots-Zarqa	Complete facilities of the Officer's club consisting of Large Kitchen, a Hall, 3 public Toilet rooms (4 washing basin, 4 W.C.'s and 4 showerheads in each) and bedrooms.	Mixers of washing basins and sinks, showerheads, toilet flushes.	Based on visit to the officers club on April 24/2000 we found out that none of the WSDs installed still exist. Their average water consumption for the whole facility is around 250 - 300 m3/day.

Chapter 8

ANALYSIS OF FINDINGS AND RECOMMENDATIONS

The WEPIA study reveals that the adoption of Water Saving Devices (WSDs) by 85% of large water consumers in Jordan provides potential water savings of about 7.5 MCM from the Public sector and about 7.6 MCM from the private sector over a ten years period in a cost effective manner. This quantity of water saved is extremely valuable, (this is more than the amount of water annually collected in a large dam such as Mujib). This is especially important to a country that is suffering severe water shortage such as Jordan. Achievement of these goals, however, is dependent on many factors including social, policy, regulatory, financial, and technical issues. Each chapter of this document has made pertinent and important recommendations. Before the conclusion of this document and a recapitulation of the important findings and recommendations, a few in particular need to be highlighted further and this section will do so.

PRINCIPAL RECOMMENDATIONS

WEPIA strongly recommends that the entirety of the 85% targets be tackled as soon as possible. There are several reasons for this. *Firstly* the water savings from tackling the entire 85% of both private and public are spectacular. Combined with the rate of return, it is an easy decision. *Secondly*, despite the frustrations of the previous demonstration projects, there is simply no doubt that WSDs are an effective tool in water conservation. Sufficient evidence exists in many parts of the world and even in Jordan, that they are effective in reducing water consumption by at least 30%. Coupled with a vigorous leak detection program, this can be a huge savings in water for Jordan and achievable in a short amount of time. *Thirdly*, the scale and magnitude of the enterprise will create its own dynamism. The people who will be most affected by the activities are arguably, the most influential people in the Kingdom. They are Captains of Industry, CEOs,. Government leaders. The Assessment clearly showed that maintenance engineers are important to the success of any retrofit and they support the use of WSDs but they are highly dependent on upper management and owners to obtain the funds to implement them. When these influential persons are mobilized, it is only a matter of time, and short at that, before the general population follows the example. From a social marketing viewpoint the opportunities are immense but they require synchronized actions (e.g. policy and regulatory changes; changes in the WSD marketplace; training programs established for different levels of targets; low cost bank loans made available; study tours for select sectors; massive promotional activities to the various target groups mentioned) in order to effect them. Interestingly, what is achievable at this scale is not

nearly as achievable at a smaller scale. Efficiencies of scale operate to lower costs.

Should USAID and the MWI choose not **to take advantage of the opportunity than the dynamics of the situation change drastically. Then the public and private indicators and targets for WEPIA need to be altered to fit the reality of the situation. While social marketing can indeed make great strides in persuading the private sector to change their behavior, the kinds of investments required by both public and private sector are simply not currently available in Jordan. The El Bashir Hospital study in the appendix clearly demonstrates that the scale of impediments to retrofitting many buildings were simply not known at the time WEPIA was designed. The study also shows that in the long-term it is less an emphasis on immediate retrofitting that will save water, but rather a focus on a long term policy and regulatory strategy that will affect the entire country. If the funds are unavailable for large scale activity, this study then recommends a reduction in the number of private buildings to be retrofitted. When the number of public buildings to be retrofitted drops from 85% to less than half that number the dynamism and visibility that might have been generated by the possible savings in water also drops. This lack of visibility robs social marketing strategies from some of the fuel required to create interest.**

It is important to digress a little here to recapitulate what some of the strengths of a social marketing program are and why use of social marketing in environmental programs has to be carefully monitored. In most social marketing programs (family planning, oral re-hydration, immunization), there is an obvious benefit to the target audience once they comply with the messages being passed to them. Benefits are simple and visible: children do not get diseases, women do not get pregnant, babies recover from diarrhoeal diseases. It is this ability to reach and touch the personal interest of the consumer that makes social marketing so effective. In these same sectors there are rarely negative behaviors that have to be overcome, only new behaviors to target. In environment and in the water sector in Jordan in particular the same factors do not apply. Persuading a 2 or 3 star hotel owner to adopt WSDs means requiring him to invest in several activities that s/he may perceive as negative to his interests. And all

this, prior to his seeing any rewards. Negative results from compliance may include disruption of services to clients, and paying out for unanticipated and unwanted devices. The rewards in cost savings are often negligible as water prices in Jordan are comparatively low and the savings in water accrue, not to the him, but to the State. Similarly for industries to demonstrate water savings they need to invest in water clean-up at the waste stream end. This is negative cash flow for most industries. They have already purchased the water (often from tanks or their own wells), regulations on re-use prohibit most of them from re-using the water and requiring them to pay for clean-up systems where they cannot directly benefit economically is almost too much to ask. Businesses don't stay in business by spending money on things they do not need and cannot use. Only regulation can obtain compliance in these cases. A very few will be able to streamline their production processes to economize on water, but most industries are already working at top efficiency. Given this new picture of the private sector, it is important that USAID and AED reconsider what is possible and focus on those actions that will have the most impact in the short time WEPIA is being implemented.

TECHNICAL RECOMMENDATIONS

1. Perhaps the most important technical recommendation stemming from the study has to do with policy and regulation. It is clear that without policy and regulatory changes in a variety of areas, compliance will be uneven and savings will be less than optimal. The study then recommends that the Ministry of Water and Irrigation, with WEPIA assistance, develop policies, regulations, standards and specifications, as well as incentives to encourage rapid retrofitting by large and small consumers and require all future construction to be fitted with WSDs at the time of construction. This can be done in several ways. For future construction the Ministry of Public Works provides guidelines for construction in which plumbing codes are established. These guidelines and the codes for construction of all relevant Ministries (Education, Tourism and Antiquities, JVA, etc…) should all specify that WSDs MUST be installed wherever possible. For retrofitting of existing sites, MWI can begin a graduated process over five years of encouraging voluntary compliance in the early years, coupled with incentives and rebates, followed by stiffer requirements and eventually penalties. Chapter 7 outlines the steps that might be taken. If these measures are quickly instituted the water savings after five years will be enormous. Where possible, representatives of the appropriate sector should be invited to participate in the discussions on regulation, both so that they can see the importance the Government is giving this issue and to ensure that the regulations are fair and do-able.

2. **The willingness of large consumers to retrofit their own buildings with WSDs is generally dependent on availability of funds to cover the anticipated cost. Even in cases where**

owners or managers were convinced of the cost effectiveness of installing WSDs, many of those interviewed by the assessment team, public and private, expected the Government/WEPIA to cover their costs. This finding is consistent with a previous study on the willingness of residential and non-residential subscribers to pay more for better water services, in which the majority of subscribers wanted better services but without paying an additional cost. The exception to this rule is the case of the Amra Hotel. The senior maintenance engineer of that hotel persuaded his managers to purchase and install WSDs. He has kept careful documentation since that time of the water and cost savings for the hotel. He has even managed to persuade other five star hotels to follow his example and there is now a group of concerned engineers of hotels that meet regularly and share their experiences about water and other issues. Finding such an innovator, who is at the same time held in esteem by his peers, is not always easy but if WEPIA's communication strategy to the private sector is to succeed, it must certainly take this into consideration. The corollary to this is to ensure that low interest loans are available to those in the private sector for whom retrofitting would prove a genuine hardship or would be economically difficult (e.g. private and parochial schools, some industries). At the same time support needs to be provided to suppliers, manufacturers and distributors to ensure that the quality of their merchandise is compatible with Jordanian needs.

3. **WEPIA needs to identify strategies to develop and institutionalize training programs on water conservation with emphasis on WSDs. These programs should focus on subscriber attitudes as well as technical issues. Practical training is particularly encouraged specially on issues like leaky fixtures and retrofitting with WSDs. Some of fixtures recommended by WEPIA are not previously known to**

Jordan and misuse or poor maintenance can eradicate any savings expected. The study did not examine the savings to be made from a leak detection program in such sites, but the savings in water can be enormous when added to the savings from WSDs. The MRO/WEPIA study has also pointed out that while most buildings admit they have maintenance programs, in actuality they seem to be very strong in some sectors (5 star hotels) and very weak in others (public buildings). In Government buildings it is often the janitorial staff that "repairs" leaks, generally by turning off the offending faucet or leaky toilet tank. These individuals become the front line for training in preventive maintenance. In the public school system there is generally no engineering or maintenance staff and schools are thus dependent on the good will of the principal, the budget available for maintenance, and locally available plumbers. If plumbers are unfamiliar with WSDs they are as likely to remove them as repair them or clean them. Plumbers then become another front-line for training.

4. **A highly focused public awareness campaign to promote and communicate messages on WSDs is recommended. The number of messages that have emerged from this study are diverse but include: education in appropriate WSDs; education in simple water audits; moral and value education and awareness about the need to value public products as well as private; education and information to policy makers to create and support regulation and policies that encourage compliance. Some of these messages lend themselves to the mass media while for others a more strategic and targeted approach is called for. Methodologies may include: town meetings, documentaries, televised case studies, a newsletter, seminars, courses, group discussions, and educational curricula for schools about water conservation and WSDs. Some of the above WEPIA had**

previously factored into its program. Some, it is clear, will have to be newly created.

5. **The meetings with different stakeholders representing industry, hotels, hospitals, and government ministries highlighted a great need for technical assistance. These consumers need to find ways to conserve water compatible with their industries and compatible too with international codes and standards to which several are asked to conform. Representatives of hotels and hospitals are willing to form sectoral committees to provide and receive technical support and assistance to their peers and to WEPIA on WSDs and the best ways to install them. They are also willing to serve on multi-disciplinary policy committees with Government representatives, water experts, bankers and the like. Hospital engineers use WSDs in their hospitals and reported inefficient performance due to the fact they had selected the wrong WSDs and had poor preventive maintenance practices. They stressed the need for help in controlling leakage. These are all areas in which WEPIA will need to provide technical assistance and management.**

6. **Should USAID opt to fund only a small number of sites, the selection of these sites becomes very important. These sites should be able to present noticeable savings and influence the public. The selection requirements are somewhat contradictory. Buildings that present the most water savings may not influence the largest number of people. The question of whether to select a large site with significant savings or several smaller sites with less savings but at relatively the same cost is another example of the kind of decision that WEPIA faces. To address these factors, both technical estimates and sound professional judgment are needed. This will require forming a group representing both technical and public awareness specialists**

to recommend the best demonstration sites. The following steps are suggested:

1) **For any potential site (start with sites from the 58 sites that were visited by WEPIA's surveyors) the anticipated savings and costs are to be calculated based on information made available by the survey. The calculations should also present the percentages of savings and costs among the different fixtures and must assume retrofitting with the best available WSDs.**

2) **Arrange the different sites as public and private and in terms of savings (total and by fixture) and cost. Graphical presentations may be helpful.**

3) **Develop criteria for selection based on both total savings and cost with the general objective of attaining the maximum savings with lowest possible cost. Other factors such as the age, accessibility, and condition of the site must be considered. Sort the anticipated public and private sites accordingly.**

4) **Evaluate and refine the list of public and private sites from step three in terms of the potential impact on the site's own sector and the public in general.**

5) **Confirm findings by conducting actual audits of the sites from step 4 before , purchasing WSDs and implementing a retrofit program. This is necessary due to the tremendous variability in plumbing fixtures used in Jordan.**

Mr. Tom Pape, WEPIA consultant and expert on retrofit programs, made the following additional recommendations for demonstration site selection:

- Sites should have more western than Turkish toilets if the primary goal is water conservation. There are almost no toilet replacement recommendations that WEPIA makes for buildings where the principal toilets are Turkish, other than valve replacement.
- Buildings should not be more than ten to twelve years old, or should be in good repair. This obviates the need to replace all pipes as well. Where pipes need to be replaced the building should be rejected. Pipe replacement increases costs considerably and the same cost-savings as has been calculated in this document cannot be anticipated.
- Sites should be selected on the basis of the largest number of fixtures (faucets, toilets, showers) and on the largest number of users of these fixtures. Savings are made per use and the more an item is used the more savings can be demonstrated.
- Where a site has mostly Turkish toilets, waterless urinals should be installed to replace some of them. Monitoring can be done to determine if they are properly used and maintained. The greatest water savings naturally comes from waterless urinals.

The specific findings of this assessment are grouped and presented in the following sections as general, policy and regulatory, technical, and financial issues.

8.1 General

A list of 506 large water consumers has been identified in this study. The criteria that was used considered only users with water consumption rates of more than 500 cubic meters per cycle (three months) as large consumers. At the beginning, 640 sites met these criteria. The list, however, was modified to exclude sites that have limited accessibility such as military sites, Royal Palaces, embassies, etc. as well as sites where consumption was primarily due to landscaping. These sites will be later taken up as part of WEPIA's general program to bring awareness but since water reduction does not stem from specific devices, they were excluded from this study. Out of the final list, 224 sites were public entities. WEPIA's demand side team surveyed 58 sites out of the list of large consumers.

Factors specific to Jordan that affects the effective use of WSDs all over the country include: the variability in water quality and the high levels of total dissolved solids (TDS) which results in scaling and then clogging of pipes and fixtures; high levels of sediment in water; variability in pressure; the wide range of types and makes in plumbing fixtures and fittings (not as standardized as countries like the US); and limited water availability and relatively high cost.

The supply side team identified and visited 38 suppliers in Jordan of plumbing and sanitary fixtures and found out that 22 (58%) of these suppliers carry WSDs or can provide it within a week upon request. Some suppliers (47%) were not aware of WSDs even though some of them stocked these devices in their stores. The 53% of suppliers who were aware of WSDs indicated that most of the customers are not aware of them and their uses. This survey also identified four local manufacturers of WSDs.

Post audits of seven sites that were previously retrofitted with WSDs indicate that no organized follow-up program existed to monitor the sites after the study had been concluded which may explain the missing WSDs from most of the public sites. Proper documentation and training of the maintenance personnel could have provided better long-term results from the study.

8.2 Policy and Regulatory Issues

There are currently both legal and policy barriers to implementing the widespread use of water saving devices in Jordan. Current water laws, regulations, and codes do not explicitly impose the use of water saving devices. Similarly, there are no nationally recognized standards for what constitutes a WSD. However, there are no apparent legal constraints to introducing legislation, regulations or codes that would develop national standards and mandate the use of WSDs. Mandating the use of WSDs through legislation will be more likely to achieve water conservation goals if it is done in conjunction with an appropriate enforcement mechanism.

A comprehensive water conservation strategy should include: changes in current law and policies, development of national standards and oversight, widespread availability and accessibility of water saving devices, incentives for their installment and use, better water management and oversight, and public education about water conservation and the effectiveness of using WSDs. Our recommendations for changes in legislation, regulations, and policy include the following:

8.2.1 Within one year:

1. National water efficiency standards should be established and included in all of the laws relating to water use, customs and taxes, building codes, and plumbing codes.

2. An oversight committee should be established to test suppliers' compliance with national standards.

3. Licenses for new buildings should only be granted to plans that include the new national standards.

4. WSDs should be distributed and installed with water meters for all new water subscribers.

5. The Ministry of Water and Irrigation and the Customs Department should work jointly to clarify the application process for a WSD exemption to vendors of WSDs.

6. The aforementioned national water efficiency standards should be used by the Customs Department to grant full exemption for WSDs.

7. Incentives for the importation of WSDs should be created by applying a higher sales tax on inefficient plumbing fixtures and a lower or no tax on water efficient fixtures.

8. Proposed MWI incentive programs (such as the invoice prorating and monetary rewards program) should be implemented.

8.2.2 Within three years:

1. All plumbing fixtures should be labeled with flow rates.

2. All locally manufactured plumbing fixtures should comply with national standards.

3. Suppliers should be required to guarantee performance standards for a set period of time. This would help to alleviate the problem of selling inappropriate or faulty plumbing fixtures.

4. There should be monitoring of the effectiveness of all plumbing fixtures, mandatory preventative maintenance, and immediate consequences for consumers who do not comply with water laws and regulations.
5. A separate utilities court with a judge and lawyers who are trained in water law should be established (analogous to a traffic court) so that illegal users would have to face immediate consequences for their infractions.

6. Locally appropriate incentive programs for retrofitting old buildings with water efficient fixtures should be implemented.

8.2.3 Within five years:

All buildings in the large water consumer category should be retrofitted with WSDs.

8.3 Technical Issues

Given the scarcity of and the high cost of water in Jordan, it is in Jordan's best interest to engage in aggressive water conservation program. The comparison made between the consumption of available sanitary fixtures in most of the sites surveyed and the "water efficient" or "water saving" fixtures show that these properties could achieve important financial benefits through water conservation. The following could be developed and presented as voluntary measures but made mandatory at a later period.

To achieve a noticeable savings the following steps should be implemented:

Step 1: Install Pressure-Compensating Aerators on All Faucets

Current situation Most washbasin and kitchen faucets are not equipped with flow aerators.
Recommendations Equip all faucets with pressure compensating flow aerators. These water saving devices reduce the output of faucets in the washbasin to 4 liters per minute and 6 liters per minute in the kitchen faucets.

Step 2: Replace Existing Toilets with Water Saving Toilets

Current situation Most of existing toilets flush with 9 liter and above.

Recommendations Replace with new toilet fixtures that are designed to use a maximum of 6 liters per flush. For private and employees restrooms consider dual flush (3 liters for liquid waste and 6 liters for solid waste)

Step 3: Install Low-Flow Shower Heads

Current situation Most of existing showerheads have a flow rates of more 20 liters per minute.

Recommendations Once the property has found a low-flow showerhead that performs properly with the variable water pressure, prevailing management is encouraged to replace all the old showerheads with ones that use a maximum of 8-9.5 liters/minute.

Step 4: Install Waterless Urinals

Current situation More urinals are flushed by a manually controlled valve, or flushed automatically by a master valve that is actuated by a timer.

Recommendations It is recommended to use waterless urinals whenever possible. If cost prevents replacing the ceramic fixture and because of the high sediments in Jordan, it would be wise to use piston type flush-o-meter valves rather than diaphragm type valves.

Becoming a water saving entity is not a challenge that can be met overnight. It is a long-term commitment and continuous process of improvement, which should be integrated, in the daily operation at a pace that is right for each site.

8.4 Financial Issues

8.4.1 Public Sector

Cost per cubic meter of water saved ranges from $0.12 for showers to $0.74 for western toilet. Faucets present the largest water savings at a cost of $0.34 per cubic meter of water saved. For 85% retrofitting of the public sector, the estimated cost for saving a cubic meter of water is about $0.54. The total costs of retrofit are: $1,608, 218 and $3,495,974 for 25% and 85% respectively of large water consumers of public entities.

Cost Benefit ratio varies from 2.6 for urinals to 17.5 for showers and 6.2 for faucets (largest savings are expected after retrofitting). This ratio equals 3.9 for retrofitting public buildings with these WSDs.

The simple pay back period varies from 0.57 years for showers to 3.77 years for urinals and 1.61 years for faucets. A general pay back period for 85% of public buildings is 2.56 years.

Considering public facilities, cost per cubic meter of water saved ranges from $0.01 for mosques to $0.79 for universities. Government buildings present the largest water savings at a cost of $0.58 per cubic meter of water saved. For 85% retrofitting of the public sector, the estimated cost for saving a cubic meter of water is about $0.58.

Cost Benefit ratio varies from 2.7 for universities to 150.9 for mosques.

Simple pay back period varies from 0.07yrs for mosques to 3.71yrs for universities. A general pay back period for 85% of public buildings is 2.56 years.

8.4.2 Private Sector

Cost per cubic meter of water saved ranges from $0.22 for showers to $1.06 for western toilet. For 85% retrofitting of the private sector, the estimated cost for saving a cubic meter of water is about $0.66. This brings the total costs of retrofitting to $4,280,0035 for 85% of large water consumers of private entities.

Cost Benefit ratio varies from 2.0 for western toilets to 9.5 for showers. This ratio equals 3.2 for retrofitting private buildings with these WSDs.

Simple pay back period varies from 1.05 years for showers to 4.95 years for western toilets. A general pay back period for 85% of private buildings is 3.12.

For private facilities, cost per cubic meter of water saved ranges from $0.28 for banks to $0.89 for hospitals. Hotels present the largest water savings at a cost of $0.72 per cubic meter of water saved. For 85% retrofitting of the private sector, the estimated cost for saving a cubic meter of water is about $0.66.

Cost Benefit ratio varies from 2.4 for hospitals to 7.6 for banks. For hotels, it is 3.0.

The simple pay back period varies from 1.32 years for banks to 4.19 years for hospitals. A general pay back period for 85% of public buildings is 3.38yrs.

CHAPTER 9

MANAGEMENT AND ORGANIZATIONAL RECOMMENDATIONS

Any retrofit program has management and supervision issues. These programs have certain fixed costs for personnel, for contracts for performing water audits, for installing the fixtures, for transporting and warehousing fixtures until they can be used. These costs do not diminish because the number of buildings to be retrofitted diminishes. They simply become a larger percentage of total costs. Typically in the US estimations of management costs (not including program costs for training, technical assistance etc…) would approximate 10-20% of the total budget. Given the complexity of this particular program costs will certainly run higher and may be difficult to determine ahead of time. AED/WEPIA will make a proposal to USAID to review the programmatic costs for installation of WSDs.

Personnel:

The study's expert participants pointed out the need to have individuals manage these programs with demonstrated hands-on expertise in retrofitting buildings, preferably with US fixtures. All of them were unanimous that it was not a job for one person, and required Arabic language skills for monitoring of contract installation teams. Given the difficulty WEPIA had initially in finding Mr. Pape himself, these experts are often few and far between. At present WEPIA technical staff does not even include an engineer on a full-time basis, and given that the WEPIA mandate is to work through environmental NGOs it is unlikely that such an expert would be found there. It is therefore obvious that the technical personnel currently configured for WEPIA needs to be rethought and perhaps changes and additions made. WEPIA will need at least one senior Arabic language expert for the duration of the cooperative agreement to manage the program under the supervision of the COP. In addition at least two junior water engineers will be required to inform other aspects of the program from training to promotion. It is preferable that these personnel be in addition to the current complement of two expatriate technical experts, if USAID can support it. It is also preferable that they come, if possible from the ranks of the individuals who worked on the assessment itself as they will be most familiar with the issues and concerns.

A Senior US retrofit expert such as Mr. Pape should also be contracted to spend considerable short-term time in Jordan supervising the purchase and installation of these items, and assisting with specifications and standards.

Installation:

There are no NGOs with the appropriate skills to implement such a technical program as installation of WSDs in a large number of buildings. Perhaps the experience of JES can serve as a cautionary note that the strength of NGOs lies rather in their ability to advocate and promote than in attempting to replicate the work of a trade specialist. WEPIA recommends that the task of installation be subcontracted out to a commercial firm with the facilities, engineering and plumbing staff to correctly install such devices. Bear in mind that WEPIA's recommendations for WSDs include such large scale items as toilets and tanks. These require considerably more skill to install than screwing in an aerator. There will consequently be costs associated with installation, warehousing, customs clearance, and the like. The firm should be

supervised in the field and on a daily basis.

Similarly to demonstrate savings in water the data base begun by WEPIA, which will be of considerable use to the MWI, needs to be expanded to include before and after figures for water consumption. Case studies need to be developed from these and economic analyses made of them. Additional short-term consulting assistance will be necessary, primarily Jordanian.

Finally there are additional administrative costs associated with more personnel, from additional office space to desks and computers, secretarial and budgetary assistance, etc…

APPENDICES

Table A-1 Governmental Large Consumers and Representative Sample

No.	Large Consumer	Location	Representative sample	No. of rep. Sites	Total
1	Ministry of Education	Amman	Ministry of Education	6	77
2	Ministry of Finance	Amman			
3	Customs Department	Amman			
4	Lower House of Parliament	Amman			
5	Jordan TV.	Amman			
6	Jordan Broadcasting Corp.	Amman			
7	Justice Palace/ Ministry of Justice	Amman	Ministry of Public Works & Housing	13	
8	House of Parliament	Amman			
9	House of Government	Amman			
10	Royal Culural Center	Amman			
11	Ministry of Interior	Amman			
12	Central Bank	Amman			
13	Natural Resources Authority	Amman			
14	Royal Scientific Society	Amman			
15	Geoographic Center	Amman			
16	Ministry of Public Works	Amman			
17	Railways Corp./Housing	Aqaba			
18	Free Zones Corp./Housing	Aqaba			
19	Vocational Training/Housing	Aqaba			
20	Social Security Corp.	Amman	Ministry of Communication	5	
21	Banking Studies Inst.	Amman			
22	Ministry of Cummunication	Amman			
23	Health Insurance Dept.	Amman			
24	General Statistics Dept.	Amman			
25	Ministry of Youth	Amman	Ministry of Awqaf	39	
26	Housing Corporation	Amman			
27	Ministry of Tourism	Amman			
28	Industrial Cities Corp.	Amman			
29	Public Transportation Corp.	Amman			

30	Water Laboratories (MWI)	Amman			
31	Amman Customs Dept.	Amman			
32	Grains Cylos/ Ministry of Supply	Amman			
33	Queen Alia Monument	Amman			
34	Ministry of Higher Education	Amman			
35	Abu Nseir Clinic	Amman			
36	Civil Aviation Auth.	Amman			
37	Vetron Dept.	Amman			
38	Consumers Corporation	Amman			
39	North Grain Cylos	Irbid			
40	North Vocational Corp.	Irbid			
41	Custom Station Ramtha	Irbid			
42	Ministry of Culture	Amman			
43	Environment Corp.	Amman			
44	Petra Region Authority	Petra/Ma'an			
45	Petra Visitors Center	Petra/Ma'an			
46	Petra Tourist Center	Petra/Ma'an			
47	Public Works Directorate	Ma'an			
48	Ma'an Cultural Center	Ma'an			
49	Railway Corporation	Ma'an			
50	Supply Warehouse	Ma'an			
51	Public Works Directorate	Mafraq			
52	Operation & Maintenance of	Mafraq			
53	Rabba Regional Center	Karak			
54	Directorate of Education	Karak			
55	Health Directorate	Tafeelah			
56	Agriculture Directorate J.V. Madi	Belqa			
57	Fannoush Center/J.V.	Belqa			
58	Rural Development Center J.V.	Belqa			
59	Ministry of Awqaf/ Directorate	Aqaba			
60	Ministry of Health/Directorate	Aqaba			
61	Customs Department	Aqaba			
62	Public Work Directorate	Aqaba			
63	Education Directorate	Aqaba			
64	Ministry of Water & Irrigation	Amman	Ministry of Water	4	
65	Port Corp./Housing	Aqaba			
66	Port Corp./Passengers	Aqaba			
67	Vocational Training	Aqaba			
68	Free Zones Corporation	Aqaba	free Zones Corporation	1	
69	Tafeelah Governorate	Tafeelah	Aqaba Authority	9	
70	Aqaba Region Authority	Aqaba			
71	Aqaba Governerate	Aqaba			

72	Ministry of Justice/Directorate	Aqaba			
73	Water Directorate	Aqaba			
74	Zarqa Governerate	Zarqa			
75	Public Works Directorate	Zarqa			
76	Ti-Qwan-Do Building	Amman			
77	Ministry of Ind. & Commerce	Amman			

Table A-2 List of Public Schools and Representative Samples

No.	Large Consumer	Consumption avg. or last quarter	Location	Represent. Sample	No. of Rep. sites	Total
1	Samir Rifai Sec.School	596	Amman	Samir Rifai Girls sec.	10	89
2	Isra'a Girls Sec. School	597	Amman			
3	Ruqaia Bint Al-Rasoul Sec. Sch.	895	Amman			
4	Al-Qabesi Sec. Sch.	576	Jerash			
5	Nazzal sec. Sch.	662	Amman			
6	Arwa Bint Abdul Muttaleb Girls sec.	617	Amman			
7	Abu alia Girls Sch.	1492	Amman			
8	Madaba Girls Sec. Sch.	5764	Madaba			
9	Prince Basma Girls Sec. Sch.	523	Madaba			
10	Khansa'a Girls Sec. School	514	Zerqa			
11	Zahran Sec. Comprihensive school	731	Amman	Omar Bin Khattab Boys Comp.	6	
12	Omar Bin Al-Khattab (Boys)	1135	Amman			
13	Mansour Kreishan Sec.	521	Amman			
14	Salt Namouthajieh Sch.	765	Salt/Belqa			
15	Arab Revolt Boys	983	Aqaba			
16	Al-Queirah Boys Sec. Sch.	735	Aqaba			
17	Al-Nuzhah Vacational Sch.	721	Amman	Al-Nuzhah girls	9	
18	Husn Girls Voc. Sch.	576	Irbid			
19	Ajloun Girls Vocational sch.	1110	Ajloun			
20	Deir abi sa'id Voc. Sch.	926	Irbid			
21	Abdul Hameed sharaf Voc. Sch.	1197	Amman			
22	Southern Shouna Vocational Sch.	11460	Belqa			
23	Al-Salt Vocational sch.	600	Belqa			
24	Khalid Abu Al-Huda vocational sch.	954	Zerqa			
25	Vocational School	4776	Aqaba			
26	Nazzal Basic Mixed Sch.		Amman	Prince Rahma Comp. Sec. Sch.	7	
27	Al-Hadeetha Comprehensive sec. Sch	564	Ghor Safi/Karak			
28	Al-Salt Girls Comp.Sch.	749	Salt/Belqa			
29	Marwa Comp. School	566	Zerqa			
30	Hay Ma'soum Comp. School	815	Zerqa			
31	Prince Rahma Girls Sec. Comp. Sch.	325	Amman			
32	Girls Comprehensive Sch.	1165	Zerqa			
33	Ateqa Bint Abdul-Muttaleb Girls sch.	611	Amman	Um Tufail Girls Sec. Sch.	22	
34	Marj Al-Hamam Sec. Sch.	949	Amman			
35	Um Tufail Girls Sec. Sch.	639	Amman			

36	Al-Jebarat sch.	943	Jerash			
37	kherbet Al-Wahadneh Girls Sch.	573	Ajloun			
38	Banat Al-Yadoul Girls Sch.	660	Ma'an			
39	Banat Wadi Mousa Girls Sec. Sch.	960	Ma'an			
40	Zeinab Bint School	504	Russeifa/Zarqa			
41	Haroun al-Rasheed school	599	Russeifa/Zarqa			
42	Um Al-Hasheem Girls Sec. Sch.	528	Ghor Safi/Karak			
43	Al-Shouna Girls Sec. Sch.	515	Belqa			
44	Al-Yabes Girls Sec. Sch.	535	Irbid			
45	Qasr Boys Sec. Sch.	552	Karak			
46	Souther Twal Sec. Sch.	524	Belqa			
47	Sukainah Bint Al-Hussein Sch.	640	Zerqa			
48	Zeinab Bint Al-Rasoul School	704	Zerqa			
49	Al Khansa'a Girls Sec. Sch.	2143	Madaba			
50	Khawlah Bint Al-Azwar Girls Sch.	529	Madaba			
51	Al-Hashemite Sch.	692	Aqaba			
52	Queirah Girls sec. Sch.	542	Aqaba			
53	Al-Marj Sec. Sch.	899	Karak			
54	Arwa Girls Sec. Sch.	1496	Karak			
55	Ruqaia Bint Al-Rasoul Basic sch.	453	Amman	Al-Hasan Bin Al-Haitham Basic Sch.	21	
56	Al-Sweifiah New Basic School	716	Amman			
57	Al-Kamaliah Girls Basic sch.	702	Amman			
58	Tla'a Al Ali School	700	Amman			
59	Ibn Zaidoon Basic Sch.	721	Irbid			
60	Al-Hasan Bin Al-Haitham Basic Sch.	943	Irbid			
61	Hasan bin Thabet Basic Sch.	557	Amman			
62	Al-Mureigh Military School	1452	Ma'an			
63	Ma'an Sec. Sch.	368	Ma'an			
64	Banat Al-Dhahia Girls Sch.	493	Ma'an			
65	Sama Sarhan Sch.	700	Mafraq			
66	Taibah Girls Basic Sch.	819	Karak			
67	Sweimah Basic Girls Sch.	708	Belqa			
68	Al-Rawdah Basic Mixed Sch.	852	Belqa			
69	Sleikhat Elem. Mixed Sch.	1112	Irbid			
70	Yarout Girls Basic Sch.	1112	Karak			
71	Ardah Intersection Basic Sch.		Belqa			
72	Aqaba Basic Sch.	689	Aqaba			
73	Damia Basic Boys Sch.	542	Belqa			
74	Al-Hashimiah Boys Prep. Sch.	661	Zerqa			
75	Yarmouk Mixed Basic School	890	Amman			
76	Adeeb Wahbeh Boys Sch.	500	Salt/Belqa	Jana'a Boys Sec. Sch.	13	
77	Mahes Boys Sec. Sch.	327	Belqa			
78	Mahes Boys Elemt. Sch.	657	Belqa			
79	Ma'een Sec. Sch.	724	Madaba			
80	Abdullah Bin Qais Sch.	933	Aqaba			
81	Hashimiah Boys Sec. Sch.	1496	Zerqa			
82	Dhuleil Boys Sec. Sch.	1448	Zerqa			
83	Prince Mohammad Boys Sch.	503	Zerqa			
84	Qudamah Bin Jafar Sch.	549	Zerqa			
85	Ibn Al-Atheer Sch.	553	Zerqa			
86	Jana'a Boys sec. School	848	Zerqa			
87	Hasan Al-Basri Sec. Sch.	705	Amman			
88	Prince Hashem Housing Sec. Sch.	527	Ruseifa/Zarqa			

89	Jubili School	773	Amman	Jubili Sch. (Baccalaureatte)	1	

Table A-3 List of Private Schools and Representative Samples

No.	Large Consumer	Consumption avg. Or last quarter	Location	Represent. Sample	No. of rep. sites	Total
1	Dar Al-Arqam	685	Amman	Dar Al-Arqam	1	19
2	Al-Omariah school	652	Amman	Itihad School	5	
3	Jordan International	613	Amman			
4	Itihad School	838	Amman			
5	Arab model Schools	929	Amman			
6	Omar Al-Mukhtar	654	Amman			
7	American Community School	856	Amman	Baccalaureate School	8	
8	Orthodox School	1357	Amman			
9	Al-Ma'aref Schools	729	Amman			
10	Al-Sa'adeh Sec. Sch.	582	Amman			
11	Baccalaureate School	6442	Fuheis			
12	S.O.S.	2301	Amman			
13	Islamic College/Jabal Amman		Amman			
14	Islamic College/Jubeiha		Amman			
15	Rosary School	745	Amman	Rosary School	5	
16	CMS Sec. Girls School	884	Amman			
17	Private Educational Center	1677	Belqa			
18	Rosary School	2211	Aqaba			
19	Educational Est.	636	Aqaba			

Table A-4 List of Universities and Representative Samples

NO.	Large Consumer	Location	Representative sample	No. of rep. Sites	Total
1	Applied Sciences Univ.	Amman	Al-Zaitounah Univ.	10	15
2	Petra Univ.	Amman			
3	Al-Zaitouna University	Amman			
4	Al-Isra'a Univ.	Amman			
5	Al-Hussein Univ.	Ma'an			
6	Amman Ahlia Univ.	Belqa			
7	Philadelphia Univ.	Jerash			
8	Jerash Univ.	Jerash			
9	Irbid Univ.	Irbid			
10	Belqa Univ.	Belqa			
11	University of Jordan	Amman	JUST	5	
12	Yarmouk Univ.	Irbid			
13	JUST	Irbid			
14	Mo'tah Univ.	Karak			
15	Al El-Bait Univ.	Mafraq			

Table A-5 List of Junior Colleges and Representative Samples

1	*Prince Alia College*	*Amman*			
2	*Amman Community College*	*Amman*			
3	*Amman University College*	*Amman*			
4	*Ajloun Community College*	*Ajloun*			

Table A-6 List of Banks and Representative Samples

NO.	Large Consumer	Location	Represent. Sample	No. of Rep. Sites	Sample
1	Cairo Amman Bank	Amman	Union Bank	5	7
2	Jordan Islamic Bank	Amman			
3	Union Bank	Amman			
4	Jordan Kuwait Bank	Amman			
5	Jordan Bank	Amman			
6	Housing Bank	Amman	Housing Bank	2	
7	Arab Bank	Amman			

Table A-7 List of Restaurants and Representative Samples

NO.	Large Consumer	Location	Represent. Sample	No. of	Total
1	Canari Restaurants	Amman	Canari Restaurants	17	17
2	Subhi Jabri Rest.	Amman			
3	Al-Waha Rest.	Amman			
4	Ata Ali restaurants	Amman			
5	Sukkariah Rest.	Amman			
6	Jordan restaurants Co.	Amman			
7	Abdullah Qasem Rest.	Ramtha/Irbid			
8	Al-Sa'di restaurants	Irbid			
9	Habeeba Restaurants	Amman			
10	Al-Qasr Rest.	Amman			
11	Al-Bawadi Rest.	Amman			
12	Al-Hadeedi Rest.	Salt/Belqa			
13	Karak Rest House	Karak			
14	Lateef Khoury Rest.	Aqaba			
15	Naif Ridwan Rest.	Aqaba			
16	Al-Balr Tourist Inv.	Aqaba			
17	Yousef Rafai Rest.	Zerqa			

Table A-8 List of Companies and Representative Samples

NO.	Large Consumer	Location	Representative sample	No. of rep. sites	Total
1	Jordan Phosphate Co.	Amman	Jordan Phosphate Co.	14	49
2	JEPCO/ Ain Ghazal	Amman			
3	Jordan Communication Co.	Amman			
4	Jordan Refinery Co.	Amman			
5	Jordan Press Corp (Al-Rai)	Amman			

6	Housing Bankl Commercial Center	Amman			
7	Caterpiller Co.	Amman			
8	Jordan Insurance Co.	Amman			
9	Al-Taibat Co.	Amman			
10	Jordan National Power Co.	Amman			
11	Jordan Communication Co.(Tla'Al Ali)	Amman			
12	JCC/ Vocational Institute	Amman			
13	NEC/ Power Station	Karak			
14	NEC/ Aqaba Region	Aqaba			
15	United Insurance Co.	Amman	Jordan Potash Co.	11	
16	Tourism Hotel Co.	Amman			
17	House of Finance Co.	Amman			
18	Jordan Real Estate Installation Co.	Amman			
19	Arab Stores & Business Center Co.	Amman			
20	Arab Food Industries Co.	Amman			
21	International Food Co.	Amman			
22	JEPCO (Main)	Amman			
23	Odeh Naber Co.	Amman			
24	Tawfic Gharghour & Sons Co.	Amman			
25	Service Master Co.	Amman			
26	White Star Co.	Amman	Arab East Investment Co. (Amman Municipality Public Library)	24	
27	Jordan Valley Co.	Amman			
28	Conel Cars Co.	Amman			
29	Agarco	Amman			
30	Jordan Real Estate Complexes Co.	Amman			
31	Jordan Investment Co./ C Town	Amman			
32	Fakhri Twal & Bros. Co.	Amman			
33	Arab East Investment Co.	Amman			
34	Jordan Arab Co.	Amman			
35	Said Turk Co.	Amman			
36	Abdul Hadi Co.	Amman			
37	Arab Development Co.	Amman			
38	Taba' Contracting Co.	Amman			
39	Arab Commercial Co.	Amman			
40	Manhal Universal Est.	Amman			
41	Commercial Facilities Est.	Amman			
42	Faisal Malhas Est.	Amman			
43	Jordan Taiwan Co.	Amman			
44	Tourist Projects Co.	Amman			
45	Al-Fahoum & Part. Co.	Amman			
46	National Contracting Co.	Amman			
47	Jordan Press & Publishing Co.	Amman			
48	Jordan Syrian Transportation	Amman			
49	Jordan Investment	Amman			

Table A-9 List of Factories and Representative Samples

NO.	Large Consumer	Location	Representative Sample	No. of Representative Sites	Total
1	Al-Hikma Pharmaceutical	Amman	Al-Hikma Pharm.	16	48
2	Jordan Tobacco & Cigarettes Co.	Amman			
3	Hijazi Food Industry	Amman			
4	Hijazi & Ghosheh Industries	Amman			
5	Universal Chemical Industries	Amman			
6	Sipes Paint Indust.	Amman			
7	United Pharm. Indust.	Amman			
8	Al-Hayatt Pharm. Industrial	Amman			
9	Jordan Refrigeration Co.	Amman			
10	Int'l Tobacco & Cigarettes Co.	Amman			
11	Arab Vetron Products Co.	Amman			
12	Sukhtian Factories Co.	Amman			
13	South Agricultural Co.	Amman			
14	Dar Al-Dawa Factories	Amman			
15	Cosmatics Industries Co.	Amman			
16	Jamil Abu samra Factory	Belqa			
17	Marble&Natural stone Manufacturing Co.	Amman	Arab Aluminum Manufacturers	22	
18	Mahmoud Ismail Marble Factory	Amman			
19	Nile Industrial Co.	Amman			
20	Anostroy Equipment Industry	Amman			
21	Zuheir Asfour Industrial	Amman			
22	Bakheet Mill	Amman			
23	Universal Kitchen Industries	Amman			
24	Arab Industries Co.	Amman			
25	Jordan Plastics Co.	Amman			
26	Rafia Industrial	Amman			

27	Jordan Cypriot Co.	Amman			
28	Kabatilo & Bahlawan Ind.	Amman			
29	Jordan Production	Amman			
30	Jordan Marble & Granite	Amman			
31	United Metal Industries	Amman			
32	Sakr Engineering Industries	Amman			
33	Tawfiq Al-Taher Co.	Amman			
34	Carpet Factory	Amman			
35	Elba House Co.	Amman			
36	United Steel Co.	Amman			
37	United Textile Co.	Amman			
38	NEC/Cement Poles Factory	Amman			
39	Subhi Jabri Factories	Amman	Jordan Dairy	8	
40	Egg Production Co.	Amman			
41	Cattle Food Industry	Amman			
42	Ata Ali Factory	Amman			
43	Arab Denmark Co.	Amman			
44	Halawani Industrial Co.	Amman			
45	Al-Morouj Dairy	Amman			
46	Abdullah Moh'd Industrial	Amman			
47	Pepsi Cola	Amman	Pepsi cola	1	
48	Fertilizers Factory	Aqaba	Municipality Slaughterhouse x4	1	

Table A-10 List of Public Hospitals and Representative Samples

NO.	Large Consumer	Location	Representative Sample	No. of rep. sites	Total
1	Al-Basher Hospital	Amman	Al-Bashir Hospital	1	23
2	JUST Hospital	Irbid	JUST	6	
3	Jordan University Hospital	Amman			
4	Mental National Center	Fuheis			
5	Princess Basma	Irbid			
6	Zarqa Gov.	Zarqa			
7	Ghor Al-Safi	Ghor Safi/Karak			
8	Ma'an Gov.	Ma'an	Mafraq Gov.(Jordan Hospital)	5	
9	Mafraq Gov.	Mafraq			
10	Jerash Gov.	Jerash			
11	Prince Faisal	Zarqa			
12	Al-Hussein Hospital	Salt			
13	Princess Rahma	Irbid	Princess Rahma	8	
14	Princess Badeea'h	Irbid			
17	Iman Hospital	Ajloun			
18	Al-Nadeem Hospital	Madaba			
19	Princess Raya	Koura			
20	Karak Hospital	Koura			
21	Al-Karameh Mental	Amman			
22	Al-Amal Cancer Center	Amman			

23	Madaba Hospital	Madaba	Red Cresent(Rosary Hospital)	3	
24	Red Cresent	Amman			
25	Souther Shona ss	ss / J.V.			

Table A-11 List of Private Hospitals and Representative Samples

NO.	Large Consumer	Location	Represent. Sample	No. of rep. sites	Total
1	Jordan Hospital	Amman	Jordan hospital	3	32
2	Islamic hospital	Amman			
3	Al-Khalidi	Amman			
4	Arab Heart Center	Amman	Arab Heart	6	
5	Ibn Al-Haitham	Amman			
6	Mu'asher Hospital	Amman			
7	Specialized Hospital	Amman			
8	Ibn-Al-Nafees	Irbid			
9	Mafraq Specialized	Mafraq			
10	Losemilla	Amman	Rosary Hospital	23	
11	Al-Shmeisani	Amman			
12	Palestine hospital	Amman			
13	Al-Amal hospital	Amman			
14	Jabal Amman Maternity	Amman			
15	Child Care	Amman			

16	Malhas Hospital	Amman			
17	Aqleh Hospital	Amman			
18	Italian Hospital	Amman			
19	Queen Zein Hospital	Amman			
20	Optical Hospital	Amman			
21	Jerusalim Hospital	Amman			
22	Al-Ahli Hospital	Amman			
23	Amman Surgical	Amman			
24	Shabib Castle	Zarqa			
25	Olive Mount	Zarqa			
26	Al-Hikma	Zarqa			
27	Rosary Hospital	Irbid			
28	Irbid specialized	Irbid			
29	Qwasmi	Irbid			
30	Jerash Specialized	Jerash			
31	Italian Hospital	Karak			
32	New Aqaba	Aqaba			

Table A-12 List of Five Star Hotel and Representative Samples

NO.	Large Consumer	Location	Representative sample	No. of represented sites	Total
1	Le Meridian Amman	Amman	Jordan Intercont.	3	10
2	Grand Hayyat Amman	Amman			
3	Jordan Intercontinental	Amman			
4	Aqaba Movenpick	Aqaba	Aqaba Movenpick	3	
5	Petra Movenpick	Petra			
6	Dead Sea Movenpick	Dead Sea			
7	Amman Mariott	Amman	Holiday Inn	4	
8	Radisson SAS Amman	Amman			
9	Regrency Palace	Amman			
10	Holiday Inn	Amman			

Table A-13 List of Four Star Hotel and Representative Samples

NO.	Large Consumer	Location	Representative sample	No. of represented sites	Total
1	Amra Forum	Amman	*Amra forum*	5	20
2	Alia Gateway	Amman			

3	Jerusalim Inter.	Amman			
4	Grand Palace	Amman			
5	Petra Forum	Petra			
6	Aqaba Gulf	Aqaba	Aqaba Gulf	4	
7	Radisson SAS Aqaba	Aqaba			
8	Dead Sea	Dead Sea			
9	Ashtar	Ma'in			
10	Petra Panorama	Petra	Dana Plaza	7	
11	Dana Plaza	Amman			
12	Amman Int.	Amman			
13	Amman West Hotel	Amman			
14	Arwad	Amman			
15	Ammon	Amman			
16	King's Way Inn	Petra			
17	Petra Plaza	Petra	GrandView / Dana Plaza	4	
18	Taybat Zaman	Petra			
19	Grand View	Petra			
20	Nabation Castle	Petra			

Table A-14 List of Three Star Hotel and Representative Samples

No.	Large Consumer	Location	Representative sample	No. of represented sites	Total
1	Middle East	Amman	Middle East	18	41
2	Amman Crown	Amman			
3	Commodor	Amman			
4	san Rock	Amman			
5	Embassador	Amman			
6	Tayche	Amman			
7	Hill Side	Amman			
8	Feras Palace	Amman			
9	Region	Amman			
10	Toleedo	Amman			
11	Arab Hotel suites	Amman			
12	Sandy Palace	Amman			
13	Magestic	Amman			
14	Adoun	Petra			
15	Petra Palace	Petra			
16	Petra Rest House	Petra			
17	Hijazi Palace	Irbid			
18	Palm Palace	Amman			

19	Hisham	Amman	Marmara	16	
20	Shepherd	Amman			
21	Al-Qasr	Amman			
22	Darotel	Amman			
23	Liwan	Amman			
24	Carlton	Amman			
25	Amman Orida	Amman			
26	Geneva	Amman			
27	Cordoba	Amman			
28	Marmara	Amman			
29	Abjar	Amman			
30	Garden Palace	Amman			
31	Gardenia	Amman			
32	Ocean	Amman			
33	Al-Waleed	Amman			
34	sik Road	Amman			
35	Coral Beach	Aqaba	Aquamarina1/Aqaba Gulf	7	
36	Aquamarina1	Aqaba			
37	Aquamarina2	Aqaba			
38	Aquamarina3	Aqaba			
39	Crestal Int.	Aqaba			
40	Miramar	Aqaba			
41	Petra Int.	Aqaba			

Table A-15 List of Two Star Hotel and Representative Samples

No.	Large Consumer	Location	Representative sample	No. of represented sites	Total
1	Al-Jabal	Amman	Gondola	7	26
2	Manar	Amman			
3	Ma'moura	Amman			
4	Merryland	Amman			
5	Gondola	Amman			
6	Rama	Amman			
7	Dead Sea Resthouse	Deadsea			
8	Babilon Tower	Amman	Caravan	16	
9	al-arz Int.	Amman			
10	Ramallah	Amman			
11	Dove	Amman			
12	Firas Wing	Amman			
13	Concord	Amman			
14	Caravan	Amman			
15	City	Amman			
16	Hala Inn	Amman			

17	Sultan	Amman			
18	Qasr Hisham	Irbid			
19	Razi	Irbid			
20	Joud	Irbid			
21	Al-Zaitounah	Aqaba			
22	al-Shoulah	Aqaba			
23	Al-Shweikhi	Aqaba			
24	Al-Cazar	Aqaba	Al-Cazar/Aqaba Gulf	3	
25	Nairoukh	Aqaba			
26	Al-Zatari	Aqaba			

Table A-16 List of Mosques and Representative Samples

No.	Large Consumer	Location	Represent. Sample	No. of rep. Sites	Total
1	King Abdullah Mosque	Amman	King Abdullah Mosque	1	21
2	Al-Huseini Mosque	Amman	Al-Husseini Mosque	1	
3	Uhod Mosque	Amman	Irbid Grand Mosque	19	
4	Bilal Mosque	Amman			
5	Abu Ther Al-Ghafari Mosque	Amman			
6	Al-Wihdat Mosque	Amman			
7	Al-Shailiah Mosque	Amman			
8	Al-Hashemi Mosque	Irbid			
9	Irbid Grand Mosque	Irbid			
10	Al-Hashemi Mosque	Jerash			
11	Mo'ath Bin Jabal Mosque/ Ramtha	Irbid			
12	Khirbit Al-Wahadneh Mosque	Ajloun			
13	Hai Al-Dubai Mosque	Amman			
14	Suhail Bin Hamad Al-Kyali	Amman			

15	Ma'an Grand Mosque	Ma'an			
16	Salehi Mosque	Ma'an			
17	Abu-Obeidah Mosque	Mafraq			
18	Omari Mosque	Karak			
19	Al-Hasan Mosque	Aqaba			
20	Al-Hussein Mosque	Aqaba			
21	Abi Thar Mosque	Aqaba			

A-17 Demand side survey form.

WEPIA
P.O. Box 850561, Amman 11185, Jordan
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Control # ☐☐☐ ☐

Surveyed ☐ Yes ☐ No

Function Code ☐

Sub function Code ☐

Governerate Code ☐

FORM DST-1

DEMAND SIDE SURVEY FORM

Date: / /2000

This form was filled by ☐

Please check and fill the information that best describes your industry:

☐ Hotel Year Built ☐ No. of Rooms ☐ No. of Beds ☐

☐ Hospital Average No. of Daily Guests/ Patients ☐

Total Number of Staff ☐ Day Time Shift ☐ Evening Shift ☐ Night Shift ☐

☐ Business Type of Business ☐ Year Built ☐

☐ Government No. of Staff ☐

☐ Others _____ No. of Customers / day ☐

☐ School Common Building Year Built ☐

☐ University Common Building

☐ Others _____

	Shift 1	Shift 2	Total
Number of Staff	☐	☐	☐
Number of Students	☐	☐	☐

Housing Faculty ☐ Year Built ☐

Students ☐ Number of students/Staff Living in the Building ☐

Nurses ☐

Organization Name ☐

Organization Address and Telephone Number ☐ ☐

Contact Person Name, Title and Telephone Number ☐ ☐ ☐

The department or person in charge of the maintenance in the building ☐

(1) Are you aware of Water Saving Devices? If no go to Item 6. ☐ Yes ☐ No

(2) If yes, do you have them installed in your facilities? ☐ Yes ☐ No

(3) Check what types of Water Saving Devices are installed in your facility

☐ Basin Mixer, Faucet, Taps ☐ Showerhead ☐ Urinals ☐ Toilet Flush

(4) If yes, who recommended them ☐

(5) If yes, did you notice any change in water consumption before and after installation and approximately what is the percentage of savings ☐ Yes ☐ No ☐ %

Fixture	Type	Location	Year	No.	Avg. Flow Rate L/ min	No. Inspected / No. Leaking	Source	Make	Model & Description
Urinals Total No. ☐									

Types: F = Flush-o-Meter; A = Automatic timer; M = Manual Tap; S = Self closing Tap; I = Infrared Actuator

Location: S = Staff Only; C = Common Area/Customers

Fixture	Type/ Location	Self Closing (Y/N)	Year	No.	Flow Rate L/ min	No. Inspected / No. Leaking	Source	Make	Model & Description
Sinks Total No. ☐									

Fixture	Type	Location /Use	Year	No.	Avg. Flow Rate L/ min	No. Inspected / No. Leaking	Source	Make	Model & Description
Showers Total No. ☐									

Type: H = Hand-held; W = Wall Mount

Location/Use: G = Guests; S = Staff; C = Customers

(11) **Inventory of Other Water Using Appliances**

Boiler Total Number ☐	Blow-Down per ____		Liter / Blow-Down_____
	Blow-Down per ____		Liter / Blow-Down_____
Washing Machines Total Number ☐	No. of Machines Top Load ___ Front Load ___ Industrial ____	Volume of water Per Load Top Load ____ Front Load ____ Industrial ____	Loads per week Top Load ____ Front Load ____ Industrial ____
Cooling Tower	Tons of cooling___	No. of Blow-Down/day___	Chemicals added_____ Ozonation used ☐ Yes ☐ No
Washing Vehicles	No. of Cars washed per/day _____ Cars are washed by ☐ Bucket ☐ Hose		
Other water using Appliances (Dishwashing , steam Sterilizers..)			

(6) What stops you from installing them? ☐

(7) What is your recent yearly water consumption? ☐ JD ☐ m^3 ☐ % Tankers

(8) Range of pressure available in the building ☐ to ☐ bar

(9) **Outdoor Water Use**

Do you irrigate your garden with potable water? Yes ☐ No ☐

If yes, include approximate area (m^2) irrigated ☐ m^2

Do you use another water source for irrigation, describe ☐

Do you have any systems that allow for reuse of wastewater, gray water, and rainwater for outside irrigation? If yes please describe. Y☐ N☐ _____

(10) **Inventory of Sanitary Fixtures**

Fixture	Type	Mount	Location	Year	No.	Avg. Flow Rate L/ flush	No. Inspected / No. Leaking	Rough -in (Inches)	Source	Make	Model & Description
Toilets Total No. ☐											

Type: G = Gravity Tank; T = Turkish; F = Flush-o-Meter; H = Hidden Tank

Location: G = Guest Room; S = Staff Only; C = Common Area/Customers

Mount: W = Wall; F = Floor

Flush Handle: T = Top of Tank; S = Side of Tank; F = Flush-o-Meter